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EDITORIAL NOTES

SMOKE ABATEMENT

IT will be recalled that early in the year the National Smoke Abatement Society issued a memorandum on smoke prevention in relation to initial post-war reconstruction—a survey and series of proposals for the prevention of smoke in the new construction that must be begun immediately after the end of the war, and which therefore must be planned before then. We referred to the memorandum in the "JOURNAL" of March 4, calling attention particularly to the suggestion that the chief problem is the supply, in correlation with the volume and range of housing, of smokeless fuels suitable for open grates and other appliances, and that the question should be examined by a Government committee representative of Government departments, fuel and appliance industries, and town planning, housing, and smoke-abatement authorities. It was urged specifically that the supply of activated cokes which will burn in any type of grate should be made certain, and that an early and definite announcement in respect of the methods of heating to be used in post-war housing should be made on behalf of the Government. The plea was put in that the Central Housing Authority should decline to sanction any housing scheme unless provision was made for the adoption of smokeless methods.

Smoke prevention is not a minor consideration. Smoke causes ill-health and a vast waste of time and energy; it is inimical to fuel conservation. If we do not eliminate the nuisance, planning for sunlight and air with roof gardens and the like loses its force. We learn that the Society's memorandum was in the main well received by the local authorities to which it was addressed, but there has not been unanimity. One local authority passed the resolution that the Society "be informed that so long as it remains necessary for the best leaders and organizers to give their attention to the war effort, the Council would prefer that the consideration of post-war reconstruction problems of this nature be deferred until they are free to give such problems the consideration they deserve." It is to be wondered when the problem will receive attention; and a resolution of the nature does seem to point to the need for greater unity of general policy among local authorities and agreement on the problem of smoke prevention. Last week information was published concerning the first report of Birmingham's plan for a new city. The reconstruction committee ascertained that during the next 10 to 30 years approximately 100,000 houses will have to be provided. The plan goes beyond the confines of the city's boundaries; it might be found desirable to create a suburb or suburbs on the lines of the Wythenshaw Estate, Manchester; and the chairman of the reconstruction committee has said that if there were to be dependence on the old-fashioned methods of loans to local authorities at 3 or 4% interest Birmingham could not perform its necessary share of the national plan. They must have either a Government loan free of interest or else Government grants up to 90% or, in certain cases, 100%. Can one contemplate with equanimity any plan of the sort which does not provide for the prevention of smoke? It is a problem of first-rate national importance, and post-war there will be a real opportunity of tackling the matter effectively. The general principle should be agreed upon and the plans should be formulated now.

The President of
The Institution of Gas Engineers,
Mr. E. V. Evans, and Mrs. Evans,
send to all members of the Institution and to others intimately connected with the Gas Industry, their Cordial Greetings and Sincere Wishes for Christmas and the Coming Year.

So we welcome yet another memorandum by the National Smoke Abatement Society—this one submitted at the invitation of, and to, the Design of Dwellings Sub-Committee of the Ministry of Health's Central Housing Advisory Committee. It is concerned with design and equipment in post-war housing in relation to smoke prevention. It is argued that technically there is nothing to prevent the achievement of domestic smoke abolition within ten years or so following the war, but that for the purpose the requisite changes and developments in fuel usage must be a deliberate part of our post-war social planning. Design and equipment of both dwelling-houses and industrial plant must conform to the needs of a scientifically planned fuel utilization policy. We must not equip new houses or new industrial plant with appliances technically already obsolete. The post-war housing programme will either add to existing sources of smoke pollution or it will be planned for smokelessness. If capital cost is considered in relation to the economics in fuel consumption that may be attained, the standards of domestic heating could, we think, be quickly and notably raised. The aggregate economy in fuel consumption would be of great national value. The completely smokeless home is not a Utopian ideal to be achieved only by effort or sacrifice.

The memorandum discusses structural factors, recommending heat insulation of outer walls, the building of chimneys into inside walls, and the giving of attention to flue design, lagging, and so on. It deprecates the manufacture or installation of combination ranges carrying out the triple functions of space heating, cooking, and hot water supply, and it stresses that unless there is reform in regard to the open fire the greater part of the domestic smoke nuisance will continue unchecked. It goes on to say that the problem would be solved by the abolition of the open fire, "which in the course of time is likely to become obsolete on grounds of inefficiency and the unnecessary labour it required. The erection of houses without open fires may be encouraged, but for the present the majority of the population are accustomed to and desire open fires, and one should be provided in the main living room, but generally not elsewhere, of new houses." But the open fire must be rendered smokeless; and it is suggested that special open grates suited to the burning of coke should be required to be installed in all houses to be erected after the war. The special grates are likely to be available in improved forms after the war, and are in any case probably the most efficient form of open solid fuel fire available, and the fact that they are equipped with a permanent means for gas ignition adds to their convenience. Then there are the possibilities of the convector type of fire consuming smokeless solid fuel. Our experience of this type of fire leads us to an optimistic view of its development and installation post-war. It is efficient and economical and requires very little labour. The Society further urges a much wider use of central heating, not necessarily in place of, but supplementary to, sources of radiant heat, gas or electricity. If such primary warmth was provided gas would also, it is considered, be more widely used.

The memorandum, which seems to us well balanced in its numerous suggestions, some of which we have outlined above, is confined to the design of houses and the provision of heating appliances. But the domestic solid fuel boiler, the special open fire grate, the convector appliance, will in fact burn bitu-

minous coal. It would seem therefore that the equipment for smokeless heating should be accompanied eventually by regulations or legislation to ensure the use of the appropriate fuel. This might be done by extending the provisions of the Public Health Acts so that for specific new houses or housing areas the emission of smoke would constitute a statutory nuisance. We know, of course, the arguments against regimentation, but it might be one of the best things that could happen to the individual and the community if regimentation was practised in regard to smoke abatement and people were not allowed to burn raw coal.

COAL OUTPUT AND FUEL TARGET

IN the "JOURNAL" of Nov. 25 we mentioned that if every family saved 5 lb. of coal a day during the heating season, the nation would save over 5½ million tons a year. The following week we referred to the reverse side of the picture—production as contrasted with consumption—and remarked that every 1% of additional absenteeism among coal face workers represents a loss of production of about 2,000,000 tons a year. The current figure of "unexplained" absences is 3%, which represents 6,000,000 tons a year. Now another cause of loss is the lessened output of men when they are at work. The output for each man-shift worked at the coal face was 2.96 tons in 1938; 2.98 tons in 1939; 2.95 tons in 1940; 2.94 tons in 1941; and in the first 10 months of this year 2.86 tons.

As between this year and last year, therefore—and this has been pointed out pertinently in *The Times*—the average output of each man at the coal face is 1.6 cwt. a day less. More men are working in the pits now than last year, when the number of man-shifts worked at the coal face was 70,000,000. Taking that figure as the basis of a calculation, the fall in output of 1.6 cwt. a day for each man would produce a total loss in 10 months of 4,670,000 tons.

It would accordingly seem that if it were possible for each coal face worker to produce that 1.6 cwt. a day to make the figure equal to last year's production per man, and if we could get rid of the 3% of "unexplained" absences, we should account for about 12,000,000 tons of coal a year. That twelve millions is, as the Minister of Fuel has stated, the gap between production and consumption which it is essential to close.

Personal

Mr. G. W. LEE, M.Sc., F.Inst.F., has been appointed Technical Officer of the British Hard Coke Association.

* * *

Largs Town Council has appointed Mr. JOHN FOSTER, Assistant Manager, as their Gas Manager, in succession to Mr. William Marshall.

* * *

Mr. A. PICKARD, who was previously with the Knottingley and Castleford Group of U.K. Undertakings, and who has been Acting Engineer, Manager, and Secretary to the Llanelly Gaslight Company since June last, has been appointed Engineer, Manager, and Secretary to the Company as from Dec. 1.

Obituary

The death has occurred at Leamington of Mr. HENRY RAYNER, in his 84th year, after a week's illness. Mr. Rayner was formerly the Secretary of the Gas Light & Coke Company, and on his retirement, about 20 years ago, he chose Leamington as his place of residence.

* * *

The death has occurred, at the age of 75, of Mr. JOHN W. ARNOTT, who has been well known in the Gas Industry, particularly to the generation now passing to retirement. Mr. Arnott was Outdoor Superintendent of the Engineering Department of the firm of W. Parkinson & Co., having a record of 53 years' service. His duties covered not only the erection of plant, but, in the case of certain Metropolitan Undertakings, regular inspection and maintenance and thus he became a well known and trusted figure to many engineers and officials. Mr. Arnott carried in his memory an unrivalled knowledge of the existing station meters and governors in the various works which he visited.

Letter to the Editor

Small Coke Boilers

DEAR SIR,—By his reference to "Boiler Nuts," in your issue of Dec. 2, your correspondent from the London and Counties Coke Association proves my point to the hilt—that the recommended nomenclature, "*Coke No.* 3," is inadequate. As to the existing coke-hopper expedient, the Committee of Enquiry, *ipso facto*, had this appliance under review when framing their conclusion "*No.* 7"—"that it would be advantageous in small domestic hot-water boilers if the minimum fuel capacity could be increased."

My suggested coke bucket, by serving simultaneously the public's wants in 3 ways—*i.e.*, to fetch the coke, to feed the fire more cleanlily, and to increase the fuel capacity of any sized boiler, if desired, has, I suggest, the possibilities of becoming popular, and is thus calculated economically to serve the cause of coke.

43, Uxbridge Road, Hampton, Middx. Yours faithfully, H. J. TOOGOOD.

Dec. 6, 1942.

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held on Dec. 8, at Gas Industry House, 1, Grosvenor Place, S.W. 1. The Chair was taken by Sir David Milne-Watson, Bart., LL.D., D.L.

A communication from the Secretary of the British Commercial Gas Association was reported, stating that Alderman E. Grimsley, President of that Association, was compelled to retire as a representative of the Association on the Central Executive Board, owing to ill-health. It was decided that a letter should be written to the Alderman expressing regret at his severance from the Board, and conveying the best wishes of his colleagues for his early and complete recovery.

The resignation from the Board of Mr. E. Astbury, who was retiring at the end of the year, was reported. He had been a member of the Board since July, 1939. The Board regretted that it was to lose Mr. Astbury's services, and good wishes for happiness in his retirement were expressed.

It was reported that Mr. Tagg had been notified officially by the Minister of Fuel and Power that he had been appointed to represent the National Gas Council on the National Coal Board.

A letter was reported from Lord Hyndley, Controller-General at the Ministry of Fuel and Power, giving effect to the suggestion that the Public Utilities Coal Committee should be recognized as a Committee of the Ministry of Fuel and Power.

It was reported that Mr. Ogilvie had been asked to see a representative of the Ministry of War Transport with regard to certain matters arising under the recent agreement concerning demurrage.

It was reported that the National Federation of Gas Coke Associations, being now fully organized with District Coke Associations covering the whole country, desired to become a self-supporting body and to make a direct call on its members for subscriptions in the future, instead of as hitherto receiving support from the National Gas Council. This action was unanimously approved.

It was reported that the White Paper entitled "War Damage to Public Utility Undertakings, &c.," had been carefully considered by the War Damage Committee of the Council on Nov. 24, and that the Committee were notifying the Treasury that they were ready to resume discussion on the proposed legislation as soon as convenient.

It was reported that a small deputation from the Council's War Damage Committee proposed to wait upon the Ministry of Fuel with regard to the question of the making of interim payments under Section 40 (iii) (b) of the War Damage Act, 1941.

In accordance with a request that the Council should appoint a representative to serve on the Industrial Research Committee appointed by the Federation of British Industries, the Board agreed to ask Dr. Braunholtz, Secretary of The Institution of Gas Engineers, to represent them on the Committee in question.

The existing representatives were re-elected to serve on the Council of the Conjoint Conference on behalf of the National Gas Council: Mr. J. H. Cadman, Mr. R. Halkett, Mr. J. Jamieson, Mr. A. W. Smith, Col. H. C. Smith, J.P., and Mr. A. E. Sylvester.

The date of the next meeting was fixed for Jan. 12, 1943.

An Interesting Insight into the economical working of British Restaurants is the cost per head for fuel in a Corporation Restaurant in the South of England. This restaurant is equipped with all-gas appliances and the consumption is estimated at ½d. per person per day. On an average 164 lunches are served, and included in the cost of ½d. per person are 32 odd teas served daily. The kitchen is equipped with one 3-unit range having thermostatic controls, two steamers, one 50-gallon boiler, one 8-ft. hot closet with doors both sides, and one bulk water boiler. All the appliances are finished in vitreous enamel and the "hood" is of glass. This is the only all-gas kitchen in the neighbourhood, the others being run on both gas and solid fuel, but observation shows that the cost per head is lower for all-gas than for combined fuels.

Manchester Juniors

A Meeting of the Manchester and District Junior Gas Association was held in Manchester on Nov. 28, when Dr. E. W. Smith, C.B.E., Director-General of Gas Supply, addressed a large gathering.

Welcoming Dr. Smith to the meeting, the President (Mr. Graham, Lancaster) said that the Director-General advocated a national reorganization of the Industry on a voluntary basis. Since then a Post-War Planning Committee had been formed, and the re-casting of the existing structure of the Industry's national bodies had received serious consideration. Central direction was aimed at, with a unified policy for the Industry as a whole. It was not a new idea, but attempts in the past to bring it about had failed to materialize. It was not simply a post-war need; it was an immediate necessity and one which was long overdue.

Dr. Smith then gave his Address. Questions were invited and many interesting points were discussed.

In proposing a vote of thanks, Mr. H. C. Applebee (Manchester) said that it was not the first time that Dr. Smith had honoured the Manchester and District Junior Gas Association by addressing the members. Mr. F. Bell (Liverpool) seconded the vote.

Responding, Dr. Smith said it had been a great pleasure for him to have been in his home-town again.

Appliance Research

An article published in the A.G.A. *Monthly* includes information received from gas companies in America representing nearly 5 million meters on the questions of war and post-war gas sales, service, and research. Branches specifically named to conduct research projects were the American Gas Association Laboratories, Institute of Gas Technology, the utilities, and the gas appliance manufacturers. Several companies contended that research should be done by the manufacturer, but the majority thought that it should be undertaken co-operatively with the utility and co-ordinated nationally.

Following are typical comments:

1. Research, of necessity, must be made both by the manufacturer as well as by the gas company. We believe that under present circumstances the A.G.A. Testing Laboratories has nowhere near the amount of testing of appliances to do to-day, leaving considerable time to make use of the facilities for the purpose of research work. We believe that every possible help the A.G.A. Laboratories can give should be utilized in co-operation with the appliance manufacturers and the gas utilities to find out what the public needs and what it wants in the post-war era, and to develop such equipment and service which will do the Gas Industry the greatest amount of good.

2. Further improvement can and must be made in gas ranges. Broiling can be improved—oven heat can be further retained—some enamel parts still discolour and ranges could be more firmly constructed. Some of these are problems for manufacturers to solve during this breathing spell, and such fundamentals as improved burner efficiency, better baking results. and more perfect types of broiler burners could be worked out in an impartial laboratory, such as the American Gas Association Laboratories. Improvement in appearance must be sought in all appliances, because with the manufacturing facilities, the inventive imagination, and the wealth of new materials which will be released after the war we can easily be outclassed by an aggressive, far-sighted competition unless we have taken strides in the interim to perfect our present position.

3. We believe that pure research on gas and on gas appliances, where there is no immediate prospect of a financial return, should be done by the Gas Industry, preferably through the American Gas Association Laboratories. We believe that the intermission in appliance manufacture caused by the war could be utilized by the A.G.A. in doing basic research work in appliance design, with the results of such research available to all manufacturers.

4. From all that we hear our competitors, the electric, coal, and oil industries, have already made tremendous advances in the development of new appliances for using their fuel. The coal industry, for example, has developed what apparently is a practical smokeless heater. The electric industry has no doubt made just as profitable strides. If we in the Gas Industry expect to be able to compete with these other industries immediately after the war, then we should be doing something about the known faults which exist in connexion with our appliances, industrial, commercial and residential, and we should by all means then engage in strenuous research looking toward new uses of gas itself.

5. Research work should be undertaken to further improvements of residential, commercial, and industrial appliances. Also development and improvement of gas-producing methods. Development and improvement of tools used in laying gas mains and services.

6. We believe that further research could be made of premix burners that would eliminate a considerable number of service calls from the standpoint of adjustments and cleaning.

7. We should conduct surveys to determine what our customers want in the way of equipment after the war: (*a*) in the way of improvement over present equipment; (*b*) in order to develop new uses, such as laundry dryer and gas air conditioning.

Research should be directed by committees as presently organized with regular contacts with all branches of the Industry.

Coal Tar Oils for Furnace Heating

F. A. Cray, R. J. Sarjant, and H. H. Utley, writing in the *Fuel Economy Review*, remark that under present war conditions it is necessary to replace imported petroleum oils for furnace heating by home produced oils. Three grades of coal tar products are used for this purpose, namely: Creosote "A," Creosote "B," "Pool" Creosote/Pitch mixture.

The calorific value of these fuels is between 16,000 and 16,500 B.Th.U. per lb., and thus about 10 to 20% less than petroleum fuel oil, but the main difference is in viscosity. With suitably designed plant all the above fuels will give satisfactory results.

It is important that the fuels should be heated to the correct temperatures to ensure the viscosity being suitable for (*a*) pipe distribution, and (*b*) atomization at the burners.

The temperatures required for these two purposes are not necessarily the same.

Creosote "A."—This is liquid at 32°F., and can be used in most plants designed for petroleum fuel oil without alteration. The supply of this grade is limited and not generally available for furnace heating.

Creosote "B."—Creosote "B" deposits naphthalene and similar solids at temperatures below 90°F. The storage tanks should be heated either with steam coils or electric heaters to maintain a temperature of 110°F., at which temperature the fuel is entirely liquid and can be easily pumped. To ensure that the oil does not fall below 90°F. during transmission and is entirely liquid at the burners, the oil supply pipes should be heated by running a small tracer steam pipe alongside the oil pipe and lagging the two together with a heat-insulating material. Electric coil heating cable may be used for the purpose if desired.

The oil should be delivered by power-operated pumps and circulated through a ring main returning to the pumps or storage tank.

"Pool" Creosote/Pitch Mixture.—This is a mixture of creosote oil and pitch, and consists of approximately 50% ± 10% of each constituent. It has a viscosity (Redwood No. 1) of not more than 5,000 secs. at 80°F., 1,000–1,500 at 100°F., and not more than 100 secs. at 200°F.

This grade is more viscous than Creosote "B" or the heaviest petroleum fuel oil. The storage tanks must be heated to maintain the oil at a temperature of 80°F. at which it can be pumped.

A circulating system is necessary for distribution, and the pipe line should be heated by steam tracer lines or electric soil heating cable and carefully lagged. Pumps designed for handling the high viscosity oil are required and should preferably be steam-jacketed. The branch lines from the main circulating system to the burners or group of burners should also be heated with tracer lines and lagged.

The temperature of the oil should be raised immediately before the burners to a temperature of 200° F. minimum to obtain good atomization. This necessitates the installation of oil heaters immediately before each burner or group of burners. The electric type with thermostatic control is very suitable for the purpose.

It is important to note that the Creosote/Pitch mixture should be heated to 200°F. immediately before the burners, and should not be circulated at this temperature. A viscosity of about 100 secs. (Redwood No. 1) is required to give good atomization.

The pipes should be so arranged that the system can be emptied when this is necessary.

The Council of the British Gas Federation has decided that, in view of the present exceptional circumstances, the Eighth Annual General Meeting of the Federation shall be deferred until a more opportune time to be determined later.

Stewarts and Lloyds, Ltd., inform us that a Paper Control Order prohibits them from sending gratuitously any refill for the calendar cases formerly supplied, unless the recipient pays beforehand at least 1d. for each. They will be pleased to forward a refill for 1943 on request and on receipt of the remittance of one penny.

The Industrial Welfare Society has published at the price of 2s. a 64-page book entitled *Practical Canteen Catering*, designed to meet the needs of industrial canteens. It includes menus for dinners, recipes for snacks, soups, puddings, &c., the quantities given being based on portions for 20–25 and 100 persons.

Ventilation during black-out hours is the subject of a new brochure (V219) issued by Keith Blackman, Ltd., describing their light traps and black-out ventilating fans which have been installed under varying industrial conditions since the war started. The ventilating fans are produced in sizes ranging from 9 in. to 48 in. in diameter, and are designed to handle large volumes of air and to function satisfactorily even when applied in situations where smoke or oily dust-laden air has to be extracted. The illustrations include two typical arrangements for ventilation schemes in large factories.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

SCHEME OF PRECAUTIONS AGAINST FROST ON A GAS-WORKS

Reprinted from Communication No. 253 of The Institution of Gas Engineers.

THE following memorandum has been prepared by the Gas-Works Safety Rules Committee of The Institution of Gas Engineers for the guidance of the technical staffs of gas undertakings.

The Committee desires to acknowledge its indebtedness to the article on "Precautions against Frost in Gas-Works" by Mr. G. M. Gill, which was published in the "GAS JOURNAL" on Dec. 24, 1941. It should be noted that certain modifications may be required in this scheme to suit individual undertakings.

In the event of the temperature falling to and maintaining an average of 32°F., or less, for a period of 12 hr., the valveman shall notify the responsible foreman—*i.e.*, usually the power foreman or the mechanical foreman.

The responsible foreman shall immediately make the following precautions against frost :

(1) Instruct all boiler house and machinery attendants to be prepared to carry out the precautions as and where they apply.

(2) Detail men to be prepared to carry out the precautions not covered by regular attendants.

(3) Arrange for the distribution of coke braziers.

(4) Arrange for the distribution of coke where necessary.

(5) Notify the foremen of the following plant to be prepared to put frost precautions into operation on the plant under their charge: (*a*) Coal-handling plant, (*b*) coke-handling plant, (*c*) carburetted water gas plant, (*d*) purification plant, (*e*) carbonizing plant, and (*f*) valve-room.

After a period of 6 hr. from the time the responsible foreman was first notified that the temperature was 32°F. or below, he shall ascertain from the valve-room whether the average temperature for that period has been 32°F. or under. If the average temperature has been 32°F. or under and there is no sudden temperature rise at the end of this period, frost precautions shall be taken immediately and the foremen of all departments notified. In the event of the temperature suddenly rising at the end of the 6-hr. period, or the average temperature for that period exceeding 32°F., the temperature shall be watched for a further period of 12 hr., and if the temperature then averages 32°F. or less, the frost precautions shall be carried out.

Works Water Supply.—(a) *By Town Main.*—This should be at a minimum depth of 2 ft. 6 in. below ground level. If possible a constant flow of water should be kept passing through the main during the periods of frost. (b) *By River or Canal.*—(i) Suction pipes should be accessible. (ii) Suctions should be at least 2 ft. below the water line. (iii) Pumps should be kept slowly drawing water throughout the 24 hr. (iv) Ice formations round the suctions should be broken. (c) *By Wells.*—(i) Suction pipes, between the well and the pump, should be laid at a minimum depth of 2 ft. (ii) Suction pipes inside the well should be lagged to a distance of 6 ft. below ground level. (iii) The tops of the wells should be covered. (iv) Means should be provided for draining the pump and its connexions when the pump is not in use.

All water services in exposed positions should be lagged either by encasing the service in a wood case packed with sawdust, or by straw rope encased in a waterproof cover.

Fire hydrant services and all other water services not in constant use should be provided with drains to enable them to be emptied during a period of frost.

Cast iron water cocks in exposed positions are liable to burst during periods of frost. Where asbestos-packed cocks are used, the shell should be drilled through so as to enable the water to drain from the plug when the cock is closed.

Water Tube Condensers.—In severe weather careful observation must be kept on the gas and water temperatures throughout the 24 hr. A steam jet impinging on the water inlet will assist in keeping the service free. Where condensers are thermostatically controlled the water may freeze near the outlet of the condenser. In this case the thermostat should be put out of action and the water controlled by hand.

Purifiers.—Steam may be used to keep the lutes free from ice. The steam service to each set should be fitted with a stop valve. The lutes should be subject to supervision while steaming, as in the event of steam failure there is a risk of siphoning. Water circulators, No. 1 size, as used for gasholder cups, can be fitted in the lutes. If rubber hose is used to make the flexible steam connexion, it should be (i) two or three ply, and (ii) wire-bound to the screwed connexion. In addition, wire binding should be soldered.

Station Meters.—(a) *Drum Type.*—If housed in a building the building may be heated by a steam radiator, in which case a steam trap must be fitted on the outlet of the steam main. Where a meter is situated in the open or in an unheated building, it is advisable to keep the meter at work, if necessary by dividing the gas streams, or to warm the water by means of a steam jet. (b) *Connersville and B.M. Meters.*—These are not prone to frost trouble, but it has been known for ice to form in the inlet box, and, in falling, to jam the impellers. This ice formation is probably due to condensation from the gas. Where the meters are in a building, the building can be heated as in (a) above. Where they are situated in the open, protection can be obtained by lagging.

Benzole Plants (*Wash Oil Process*).—The oil as purchased must be liquid and clear at as low a temperature as is economically possible. The flow of the wash oil usually becomes impaired at a temperature of 35°F. Where the quantity of replacement oil and make-up oil is low, as is usual on works making little or no carburetted water gas this difficulty presents itself at higher temperatures (40°F.) owing to sludge formation. It is therefore advisable to replace as much of the wash oil as possible at the commencement of the winter and to introduce replacement oil into the washers more frequently during cold weather. The oil pipeline should be lagged, or kept warm by steam where practicable, and oil tanks should be lagged or otherwise protected. The oil should be kept circulating through the plant, and services should not be allowed to remain stagnant in any part of the plant.

Where the question of gas supply renders it necessary to cease benzole production during frosty weather, this should be done by ceasing distillation only—*i.e.*, the oil is kept in circulation, the washers kept in action with the gas flowing through it, and the steam shut off the still. The oil will thus become saturated with benzole and its thickening point thereby reduced.

Water should be shut off the cooler and the cooler screened by tarpaulins or other means. If the water system is a closed circuit, the water should be kept circulating, but if the system is not closed the water services must be drained.

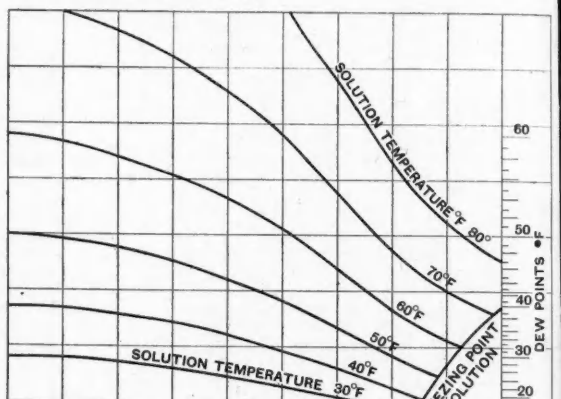

FIG. 1.—*Freezing Points and Related Dew Points of Calcium Chloride Solutions of Varying Strengths.*

Steam lines that are unprotected should be isolated and drained.

Gas Dehydration Plant.—The chief risk to be guarded against at low temperatures is the solidification of the calcium chloride solution. It is therefore advsaible to view the temperature of the calcium chloride solution at its coldest point in the plant as the working temperature of the plant. The coldest point usually occurs at the point where the solution enters the scrubbers. (The recording thermometer should be provided at this point.)

With a sudden fall of temperature the risk can be averted by diluting the stock solution with water before it is pumped through the plant, or, alternatively, by warming the solution with steam.

In either case a weakening of the solution will take place, so it will be necessary to calibrate the tank so as to ascertain the extent of the reduction of the strength of the solution in degrees Twaddell. In practice, a tank of small, but adequate capacity, containing a known volume of water, placed over the solution storage tank, will assist immediate dilution to a known degree. The point at which this dilution should be applied can be predetermined and indicated on the recording thermometer chart by drawing a red line, in the appropriate position, on the chart. The steam to the evaporator should be kept on and the flow of the solution increased until the evaporator acts as a heater.

Solidification of the calcium chloride is accompanied by an increase in the back pressure on various parts of the plant. A pressure gauge fitted on the outlet of the solution pump will provide a means of observing any such pressure increase.

The presence of ammonia in the gas will give rise to the formation of ammonium chloride, which should be periodically reduced by treating the solution with lime and heating it to drive off the ammonia.

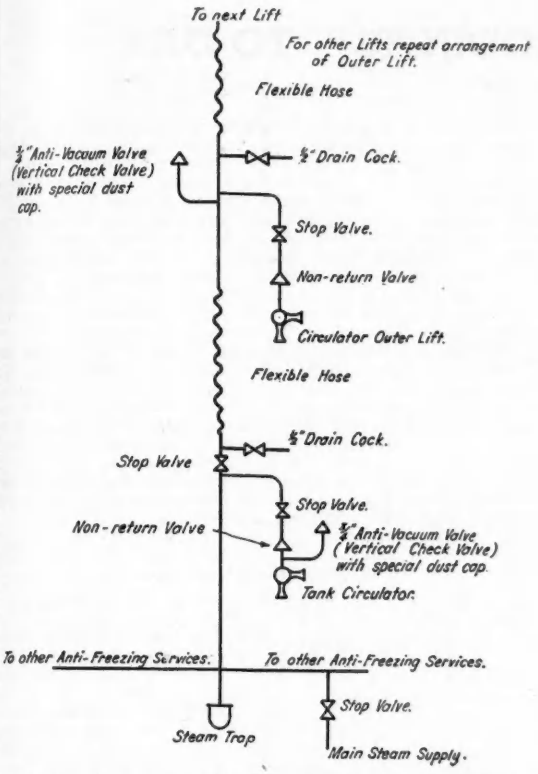

FIG. 2.—*Arrangement of Anti-Freezing Apparatus for Column-Guided Gasholders.*

NOTE.—The inlet and outlet pipe of the circulator should be set at such a level that in the event of siphoning occurring the seal in the cups cannot be reduced to the blowing point.

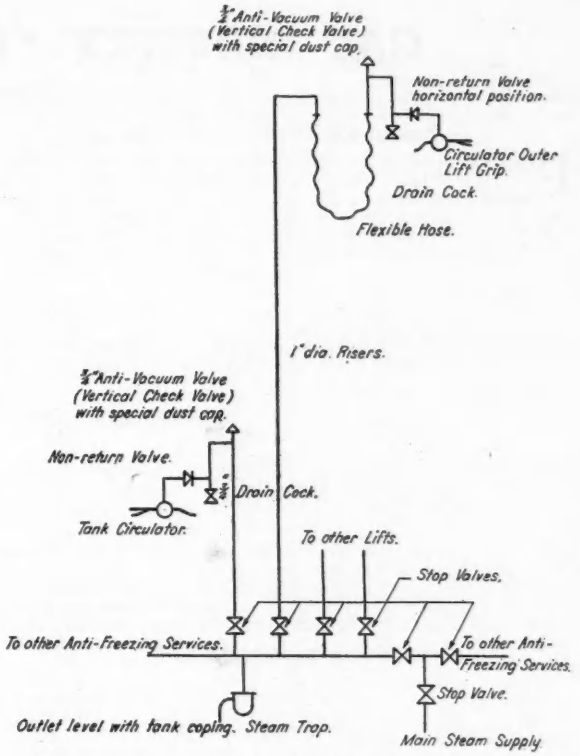

FIG. 3.—*Arrangement of Anti-Freezing Apparatus for Spirally-Guided Gasholders—Top Circulation Pipe.*

NOTE.—The outlet pipe of the circulator should be set at such a level that in the event of siphoning occurring the seal cannot be reduced to the blowing point.

Where the coolers are in an exposed position and are difficult to by-pass they should be protected by moveable louvres—*i.e.*, capable of being closed.

Steadier temperatures might be obtained, in very cold weather, by keeping the water on the coolers.

Fig. 1 shows the minimum dew points which the gas can attain after contact with calcium chloride solutions of varying strengths (°Tw.) together with the freezing point of the solutions (°F.).

Water-Sealed Gasholders.—It is essential to prevent the water in the tanks and cups of water-sealed gasholders from freezing, and steam should be available and anti-freezing apparatus fitted to the tank and cups. The water in the cups must not only be heated but must also be kept in circulation.

Tanks situated below ground, not being fully exposed to wind action, can be adequately protected by the provision of circulators. The circulators should be fitted some feet below the surface of the water and slightly pitched forwards the centre of the tank. The number of the circulators fitted should vary with the diameter of the tank.

Steel tanks situated above ground level are liable to ice formation on the internal water surface (see note on spirally-guided holders). The ice formation may be expected to take place on the windward side of the tank, and as the temperature of the tank water must be kept above 32°F. it is advisable to protect the windward side by hanging tarpaulin sheets from the gangways, the position of the sheets being changed with that of the wind direction. This sheet protection is additional to and not a substitute for the provision of circulators.

If ice formation should take place the ice should be broken and removed immediately it is thick enough to handle. An old coke fork, cut down to a suitable width, is a handy tool for this purpose. Should the cups become frozen, however, the holder should on no account be allowed to uncup.

Spirally-Guided Gasholders.—These are the greatest responsibility during periods of frost as ice formation on the surface of the water, within the holder, is liable to cause damage not only to the holder, but also to its connexions. In addition to the foregoing precautions respecting tanks and cups, which apply to all gasholders, the guide rails of spirally-guided holders must be subject to regular inspection and snow or ice formations removed.

When in use the circulators fitted to the cups will cause the cups to overflow. It must be ascertained over which guide rails the overflow is discharging, as those particular rails will be subject to rapid ice formations and will therefore require extra attention. Reference should also be made to the more detailed Report of the Committee on this matter which was published as the First Report of the Chairmen's Technical Committee, 1939–40 (Communication No. 234, November, 1940).

Anti-Freezing Apparatus (i.e., *Circulators*).—The provision of circulators is essential to prevent the cup water freezing. The steam connexions to the circulators may be of rubber or flexible metallic tubing, and must be provided with: (i) A suitable non-return valve situated close to the circulator. (ii) A stop valve fitted close to the flexible steam connexions. Every section of the steam service between the flexible connexions should be provided with: (*a*) An anti-vacuum valve; (*b*) a drain cock.

A steam trap must be fitted at the lowest portion of the steam main, and a stop valve fitted on the steam inlet to the main.

Diagrams of the arrangement of anti-freezing apparatus are shown in fig. 2 for column-guided gasholders, and in fig. 3 for spirally-guided gasholders.

Power Plant

Waste-Heat Boilers in Retort Houses.—The cooling tanks for the turbines should have the ball cocks so adjusted that a continuous and ample flow of water through the services is ensured (surplus water can be run to waste). Those services should be frequently inspected. The thermal circulating water system should be put in action on all turbines and fans.

If a boiler is put out of commission, coke braziers should be placed at the feed pump and feed main.

Boilers not under Fire.—All services should be drained as far as possible, and braziers placed in front of the boilers to warm the feed services and pumps.

Hydraulic Accumulators.—These should be protected by coke braziers.

Water-Softening Plant.—All sludge valves on the main reaction tank should be operated every four hours. Steam heating service for sludge hopper valves should be turned on. Sludge pumps should be run twice per shift. Water services should be protected by a coke brazier.

Idle Plant.—Services to plant which is idle, as well as the idle plant itself, should be drained, and where such plant is water-jacketed the water jackets should be drained.

GAS INDUSTRY "PRODUCTS" TO-DAY

[Contributed]

Breeze for Steam Generation

PRODUCTS works generally have not been slow in their efforts to conserve fuel. Large quantities of breeze are used in the generation of steam, and it was pointed out by Parrish some time ago that an overall efficiency of 62% is attainable with a boiler installation without economizers using breeze exclusively. The fuel figures given by him are worthy of record:

	%
Thermal efficiency	62.01
Loss: (*a*) Combustible matter in clinker	5.73
(*b*) Escaping in flue gases	16.53
(*c*) Balance	15.73
	100.00

The balance is accounted for thus:

	%
(*a*) Blow-down water ... ... (about)	1.00
(*b*) Evaporation of water in fuel	5.60
(*c*) Heat of clinker	2.00
(*d*) Heat of flue gases	0.78
(*e*) Combustible matter lost in flue dust	0.95
(*f*) Radiation loss	6.00
	15.73

By heat interchange between the air required for the combustion of breeze and the hot flue gases, using a needle high-pressure economizer, it is known that a further economy of 13% can be effected.

At most products works there are many steam-driven pumps and small steam engines in use, and it has been urged that all exhaust heads should be dispensed with, and that the exhaust steam should be led to a combined feed water heater-condenser, where suitable boiler feed water can be raised to 90–100°C., dependent on the quantity of exhaust steam available. In this way a further sensible economy can be effected. In cases where other sources of heat are available for preheating boiler feed water, the exhaust steam may be utilized in a calorifier for maintaining an adequate supply of hot water to washrooms, or in radiators for warming shops and stores. It should be emphasized that where condensed steam from pumps and engines is used as direct boiler feed, an efficient separator or filter should be installed to prevent oil passing to the steam-generating plant.

Ammonia and Ammonium Compounds

Sir John Russell, Director of Rothamsted Experimental Station, in the course of his Messel Lecture in July last, remarked that it was a hundred years that month since fertilizers were first introduced. That was the outstanding achievement of the chemist in agriculture. Our post-war agricultural policy was not yet formulated, but he foresaw a greater call for fertilizers. This statement cannot but be a matter of interest to those responsible for the processing of coal.

There is no change in Home prices for sulphate of ammonia. These remain "pegged," and are identical with last year, representing an advance of 48s. per ton over the corresponding price of 1938–39. Again, farmers and agricultural merchants who were prepared to place orders early were given an early-booking rebate ranging from 28s. per ton for July bookings down to 2s. per ton for bookings in December, 1942. A satisfactory response to this offer has resulted, and products works are now able to load at a reasonably equitable rate throughout the year. This is a circumstance which is highly appreciated, especially in view of the present acute shortage of labour. Manufacturing costs of sulphate of ammonia continue to advance, because fuel prices have increased, labour is more costly, and prices of repairs and maintenance materials are inordinately high. As an example in this connexion, a serious step has recently been taken by the United Kingdom Lead Manufacturers' Association. They have intimated to purchasers that they cannot continue to sell chemical sheet lead and lead pipe on an exchange basis. What this means in the case of the renewal of saturators and sulphuric acid plants is best illustrated by the following figures:

	Per ton.
Cost of chemical sheet lead under old conditions	£35 0s.
Allowance for remelted pig lead	£27 10s.
Net cost of replaced lead	£7 10s.
Cost of lead under new conditions	£38 0s.
Best allowance obtainable on the open market for remelted pig lead	£18 15s.
Net cost of replaced lead	£19 5s.

Apart from this, the cost of the fabrication of saturators and their equipment, and monitor cases, is more than three times that obtaining in 1939.

Calcutta "B" twill bags, which cost 5d. each in 1939, are not now available, and Dundee-woven hessian bags, weighing 20 oz., cost 1s. 1½d. each to-day.

Every ounce of by-product ammonia is required, and it has been suggested that considerable wastage was occurring. There are evidences that loss of ammonia still takes place. Unusually large quantities of ammonia are found in deliveries of spent oxide, and this relates to the material arising not only at small or medium-sized works, but at some large works also. Many plants have been erected for the production of concentrated gas liquor during the last three years. The Ministry of Supply, Industrial Ammonia Control, has been interested in the installation of plants, most of which are now operating.

The chemical characteristics of gas liquor vary with the processing of different coals, with the degree of control exercised, and for other reasons. A concentrated gas liquor plant can be designed for the treatment of gas liquor of a specific quality, and by the time the plant has been erected the quality has changed not inappreciably. Gas liquors arising from the treatment of coals in horizontal retorts are not difficult to concentrate up to 20% ammonia/weight in a simple form of plant. But where steaming of the incandescent coal substance occurs in vertical retorts, the quality of the gas liquor is such as to necessitate a more elaborate form of plant.

It is still felt that the ammonium sulphide content of concentrated gas liquor should be maintained as high as possible, so that not only ammonia, but sulphur units are transported.

A New Development

A new and interesting development of the semi-direct method of recovering ammonia from coke oven gas has been described by W. Tiddy. Instead of the usual saturator, a scrubber is used for absorption of the free ammonia, the gas being passed counter-current to a concentrated solution of ammonium sulphate containing 4% pure sulphuric acid. The solution leaving the scrubber is then pumped to the vaporizing zone of a crystallizer in which the sensible heat of the solution and the heat of crystallization are utilized to remove water and cool the solution by means of vacuum evaporation. The resultant supersaturated solution is then circulated over a bed of crystals contained in the base of the crystallizer. Fresh crystals are thus deposited and the heavier crystals, which gravitate to the base of the chamber, are removed with mother liquor and separated in a continuous centrifuge. The mother liquor is then pumped to the scrubber, after the addition of the necessary sulphuric acid. The advantages claimed for the process are (1) lower operating costs, (2) improved product, and (3) reduced and more uniform pressure drop.

New Solvents for Phenol

A detailed report of the investigations of the Committee on bed-bug infestation, of the Medical Research Council during the period 1935–1940, has recently been published (J. N. Walker, *Chemical Trade Journal*, 111–371, 1942). This report is particularly interesting, in that it adds considerably to our knowledge of the chemistry of heavy solvent naphtha, and has made possible the preparation of a specification for a naphtha most suitable for the purpose of disinfestation.

The search for better solvents for phenols has led to the development of a mixture of esters of various higher alcohols, with a specific gravity of 0.88 and a boiling range of 110–130°C. This solvent, to which the name Phenosolvan is given, is produced by the I. G. Farb A.G., in conjunction with the Lurgi Ges. für Warmetechnik, and the results of its extended use on a pilot plant have been described by W. Herbert (*Chemical Trade Journal*, 111–78, 1942). The extraction efficiency of the new solvent is said to be many times that of benzole, and appreciably higher than that of tricresyl phosphate (the triphos process).

These solvents, presumably, have a much better phenol-water partition coefficient than benzole, and there is less risk from fire. It would be wrong to assume that the Germans are alone in this field.

E. Brett Davies (Pitch Marketing Board) has contributed an interesting article to the *Fuel Economy Review* (21–82, 1942) about the utilization of pitch. The Petroleum Board has standardized a fifty-fifty pitch-creosote mixture. Obviously, the use of this mixture will not solve the pitch problem, although it will certainly help. From this contribution it is concluded that the main factors governing liquid pitch combustion are (*a*) the installation should be reasonably continuous in operation, (*b*) the pitch consumption should be of the order of 10 gallons per hour per burner, and (*c*) the combustion chamber should afford ample space for the development of the flame.

Spent Oxide

More spent oxide is being produced at present than in 1939. Less water-gas is being manufactured because of the scarcity and consequent increase of price of oil for carburetting. This doubtless accounts for a sensible increase in the production of sulphur. There is also reason to believe that the coal being supplied for processing at coal carbonizing works contains more sulphur. The following figures are of interest.

as representing the consumption of raw materials (in tons) in the production of sulphuric acid in this country in 1936, 1937 and 1938:

Year.	Pyrites and others.*	Spent oxide.	Brimstone and H_2S.	Zinc concentrates.
1936	404,100	161,200	61,200	160,900
1937	405,200	165,100	82,000	158,800
1938	364,400	146,200	74,500	141,600

* In "Pyrites and others" is included anhydrite.

When shipping is in such short supply, and freights are so abnormally high for the transport of pyrites and brimstone, indigenous sulphur (spent oxide) should be in great demand. But it takes time to adapt mechanical burners, hitherto using pyrites, to the combustion of spent oxide. Unfortunately, rotary mechanical burners, burning brimstone, cannot be adapted for the combustion of spent oxide. The manufacture of sulphuric acid from brimstone is a simple operation, giving a high overall efficiency and a relatively pure acid. Acid made from spent oxide is generally commercially free from arsenic, and of better quality than acid manufactured from pyrites. But unfortunately, gas-works still appear to regard spent oxide as a refuse, rather than as a product. If greater attention were given to its quality, if the tarry matter were reduced to 0.5%, if the ammonia content were kept below 1% as ammonium sulphate, if tramp iron, brickbats, broken purifier grids, and other extraneous matter were excluded, and if the material were crushed so that it all passed a 1-in. mesh screen, the Gas Industry would then have a "sulphur product," as distinct from a "gas refuse." Then would be the appropriate time to exert greater pressure to militate against the accumulation of abnormal stocks, and indeed to seek more favourable prices.

EVALUATION OF COALS FOR CARBONIZATION

AMERICAN STANDARD TEST

IN his Melchett Lecture to the Institute of Fuel Dr. A. C. Fieldner discussed the analysis and testing of coal in relation to its properties and utilization. Next to the direct use of coal as a fuel by combustion, he said, the manufacture of gas and coke is the most important present-day utilization of coal. The selection of coals for these processes and their intelligent control require not only the standard methods of proximate and ultimate analysis, but numerous other tests as well. In fact, the proximate analysis itself is a simple carbonization test in which a rough indication of the relative proportion of solid residue and volatile matter or gases is obtained. Likewise, examination of the crucible residue shows whether the coal is of a coking or non-coking nature. However, a study of the properties of coals pertaining to the production of gas, coke, and by-products is a complex problem that requires extended experimentation for its solution. Workers in these industries have from time to time devised small-scale gasification and coking tests on samples ranging from a few ounces to several pounds of coal. Some of these tests yield useful data when interpreted in the light of experience with similar coals in plant equipment. But tests with such small quantities of coal do not yield sufficient amounts of carbonization products to determine their quality as well as their quantitative yield. For these reasons and others, a committee of the American Gas Association in 1927 asked the Bureau of Mines to develop a suitable standard test (designated as the BM-AGA test) for the gas, coke, and by-product making properties of coals and to apply this test in a survey of American coals.

The results of a preliminary study indicated that a 75-lb. charge was the minimum that would give satisfactory information consistent with the purpose of the test, and a 300-lb. charge as the maximum that could be used without unduly increasing the cost of making the tests.

Other features of the desired test method decided at this time were:

1. Carbonization tests should be made on a series of samples at 100° intervals from 500°C. to 1100°C. (932°F. to 2012°F.) to show trends due to changing temperatures and to cover the entire range from low to high temperature coking.
2. The retort should be of metal, to avoid leakage.
3. The shape of the retort should be either cylindrical (heated on all sides) or rectangular (heated on opposite sides only).
4. The temperature of the outside of the retort should be kept constant and uniform during a test.
5. The coals for test should be subjected to various analyses and tests that might affect their carbonizing properties.
6. The yields and quality of the gas, coke, and by-products should be determined.
7. The first series of coals to be tested should be selected from well-known gas and coking coals for which commercial oven and retort data are available, so that correlation with commercial yields might be obtained.

A condensing, tar-precipitating, and scrubbing train was developed in accordance with the conclusions made from the preliminary study. A gas-heated furnace and a cylindrical steel retort 13 in. in diameter and 26 in. in height, holding 85 lb. to 105 lb. of coal, was used in the early part of the work. Later, an automatically controlled, electrically heated furnace was substituted for the gas-heated furnace, and a steel retort 18 in. in diameter and 26 in. in height, holding 175 lb. to 200 lb. of coal, was used for the carbonization tests at 800°C., 900°C., and 1000°C. This larger retort was found to give results in better accord with commercial practice.

It is pertinent to call attention to some of the useful information that has been obtained in this investigation, which up to the present has included some 100 coals or blends of coals.

It was not expected that the results attained by this test would approximate in every respect those in a commercial plant. The yield and quality of the gas, coke, and by-products are conditioned by the temperature of carbonization, the rate of heating, the charging density, and the temperature and time of exposure of the volatile matter before it is cooled to a point where no further reactions take place. These factors vary with operating conditions and oven or retort design.

The following relations have been shown:

1. Most of the plant yields of coke, gas, and B.Th.U. of gas per lb. of coal fall between the results obtained at carbonizing temperatures of 900°C. and 1000°C.; the gas data agree more closely with the 1000°C. results, and the coke yields with the average of the 900°C. and 1000°C. results.
2. The total yields of the light oil scrubbed from the gas plus that distilled from the tar in the 900°C. tests are approximately the same as the light oil obtained at the plants.
3. The yields of tar obtained in the 1000°C. BM-AGA tests show better agreement with plant yields than the tests at lower temperatures, although in several comparisons the plant yields are one to two gallons per ton of coal less than those from the test apparatus using the 13-in. retort; the 18-in. retort, in general, gives better agreement, but, on the whole, the tar yield of the test retort is slightly more than is obtained from by-product ovens.
4. The specific gravities of the test tars obtained at 900°C. and 1000° C. are usually within a range of 0.04 of each other, and a 1000°C. test tar agrees closely with the plant tars.
5. The ammonium sulphate yield from the test apparatus is low, owing to decomposition of the ammonia by the iron retort. The yields of ammonia at a carbonization temperature of 800°C. more nearly approach commercial yields.
6. The apparent specific gravity is approximately 0.1 less, and the percentage of cell space is usually 5 to 7 greater for the test-retort cokes than for the by-product oven cokes. This difference is probably due to the lower pressure of a smaller superincumbent charge in the test retort than in the coke oven. However, the test cokes agreed closely with commercial cokes made from the same coal in horizontal and continuous vertical gas retorts. By packing down the charge of coal in the test retort, coke oven density and porosity could be approximated.
7. The 2-in. shatter indices of the plant cokes usually are higher than those of the 900°C. 13-in.-retort test cokes, and these in turn are higher than those of the 1000°C. test cokes. However, the relative order of resistance to shatter of the test-retort cokes usually is the same as that of the plant cokes, indicating that the test method shows the relative strength of cokes from different coals. The 18-in. test retort produced cokes at 900°C. with somewhat higher shatter indices than the 13-in., and the results approached those obtained on plant cokes from the same coal.

Through the courtesy of the Canadian Department of Mines, portions of two coals that had been tested in the Department's 2-ton experimental by-product oven at Ottawa and in full-scale industrial by-product ovens were obtained for tests in the BM-AGA 13-in. retort at Pittsburgh. The results showed excellent agreement in most respects, the principal exception being the lower apparent specific gravity and the lower shatter index of the coke from the test retort.

These and other comparisons lead to the conclusion that the BM-AGA test provides a reasonably comprehensive method for assaying the yield and quality of the gas, coke, and by-products of coals without incurring the large expense of commercial-scale equipment. Its main defect is in producing somewhat smaller coke with a lower scale of resistance to shatter than commercial ovens. In this respect, the experimental oven developed by the British coke committees probably gives more satisfactory results. However, experience has shown that the plan of carbonizing each coal at a series of temperatures gives valuable information on the kind of heat treatment best adapted to the coal under investigation. The BM-AGA test has proved of great assistance in determining the effect of blending different coals, the effect of washing coal, and the influence of the addition of fusain and coke breeze to the coal.

DON'T LET THIS HAPPEN!

THERE'S an ugly name for the man who deliberately holds up work in a munition factory. What will you call the man who holds up a lorry, a rail wagon, in his private loading bay—keeps it hanging about an hour or two when it might be on its way?

Different? Well, yes! Nobody supposes that wagons and lorries are deliberately held up. But deliberate or not, the result is the same. The man who holds up transport has his hand on the very throat of our war effort.

The country asks you for 10 minutes saving in each hour of standstill time of every vehicle that comes to you from this day forward.

You know your own problems best. Tackle them in your own way
But tackle them now. Plan, encourage ideas, improvise if needs be.
Here's a starting-off agenda:

1. CLEARLY-WRITTEN LABELS
2. LABOUR-SAVING EQUIPMENT
3. BLACK-OUT WORKING
4. OPINIONS OF "MEN WHO DO THE WORK"

WE MUST GET AN EVEN QUICKER TURNROUND

Ministry of War Transport

7

Selection of Coals for Wartime Carbonization*

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WARTIME conditions create a maximum demand for all kinds of bituminous coals. The great demand inevitably makes it necessary at times to make quick decisions in selecting and using for the production of coke whatever bituminous coals may be available. This places a great responsibility on those who are entrusted with the selection, blending and preparation of suitable coking coals. They face a situation wherein it is not possible to run the comprehensive tests ordinarily used as a basis for decisions, and wherein it is necessary to use a maximum proportion of dangerously expanding low-volatile coals in order to increase the yield of coke. In such circumstances, due care must be taken to condition the coals or coal blends so that stresses and strains developed during carbonization will not cause stickers and retard production, nor cause immediate or deferred damage to the coke ovens.

This Paper describes an apparatus and procedure used to evaluate the stresses, strains, and other characteristics developed during the coking of different coals. By its use a positive answer is made available within a few hours after receipt of the coal in question.

An improved engineering model of the coke oven was perfected during 1941–42 at Everett, Mass. This model was used to reproduce the stresses and strains and various behaviour characteristics developed during carbonization. Numerous tests with several coals and blends coked in this apparatus proved that it was better, more sensitive, and more flexible than previous models. With the new model it was possible to conform with important and essential similarity requirements that must be met when running coking tests in a model to simulate the stresses, strains, plastic flow, and other characteristics developed during the coking of different coals.

This improved stress-strain tester is designed to measure and/or control the lateral stress, lateral strain, vertical stress, and vertical strain throughout the time of coking. It has air-cooled flues in the vertical piston and in the floor brick. Controlling the amount of compressed air flowing through these flues will control or prevent coking downward from the vertical piston and upward from the floor. In this way, the model may maintain a uniform, unidirectional flow of heat producing a plastic zone having substantially plane surfaces, or it may form plastic zones having the characteristically curved surfaces caused by some coking downward from the top and upward from the bottom. This made it possible to consider and measure the effect on stresses and strains of different configurations of plastic zones in different tests using the same coal.

The movable wall is suspended from a carriage and the entire weight is transmitted by roller bearings to rails mounted on top of the tester. Improved mechanical features and materials of construction have improved sensitivity, eliminated sticking, and improved the transmission of heat.

A weighing device like those used on machines of the testing materials laboratories is provided. With this device, application is made of the idea of compressive strength of the charge during the period of coking. A coking test in this stress-strain tester substitutes for the specimen of concrete in a compression test machine the material being coked in the model. In the latter case the volume change is the result of the coking process. During the period of coking some coals and blends the compressive strength of the charge is exceeded, causing a portion of the charge to fracture and move upward in the oven. In tests the lateral strain was kept below 0.02% by suitable adjustment of the lateral stress. While thus measuring and adjusting the lateral stress, the vertical load was continuously decreased according to a schedule designed to impose 2 lb. per sec. on the material between the two plastic zones during coking of expanding coals.

Data now being incorporated in a progress report will substantiate conclusions as follows:

1. It is important to determine the compressibility characteristics, or the ability of the charge during coking to shear or move upward or downward within the coke oven.
2. Incorrect conclusions may be drawn when stresses are determined by devices that neglect the dissipation of stress caused by plastic flow and upward displacement of the charge.
3. The magnitude of stresses generated during carbonization depends largely upon three factors: (1) Behaviour characteristics of the coal; (2) design of the oven; (3) the operating conditions.
4. During carbonization in coke ovens there is a tendency toward consolidation and compression increasing the bulk density of the charge, thus tending to increase side thrusts.
5. Because of their compressibility characteristics, some charges may behave so as to dissipate excessive stresses that are generated locally within the oven.
6. The relative rates of consolidation and displacement in part determine the maximum lateral thrust generated during carbonization.

Identical conclusions were drawn from data secured with an earlier model used to determine stresses and strains to evaluate suitable stress-strain ratios.

* From a Paper before the Joint Conference, Production and Chemical Committees, Technical Section, American Gas Association.

"Internal Treatment" of Boiler Feed Water

In an article in the *Fuel Economy Review* A. J. Mills observes that the advantages of "external treatment" over any method which involves treatment of the feed water after it has entered the boiler should be obvious, but there are times when other considerations render the installation of a softening plant impracticable or impossible. Space on which to build a softening plant may not be available in or near to a boiler house so that, if the boiler plant is to be kept free from scale and corrosion, "internal treatment" is the only method of achieving success. Again, if an existing softening plant is to be rebuilt or replaced by another on the same site, "internal treatment" can be used to prevent scale or corrosion in the boilers during the interim period when softened water cannot be produced. There are a few types of natural waters for which "internal treatment" is the best treatment if the boiler pressure is not greater than 150 to 180 lb./sq. in. In such cases the use of properly controlled "internal treatment" can give satisfactory results over long periods. "Internal treatment" should not be confused with the practice adopted in some cases of using boiler compounds which have not been specifically chosen to suit a particular water and set of conditions. Even when a compound is formulated to meet each special case, this by itself is not sufficient. "Internal treatment" involves not only the use of a combination of chemicals to suit any particular water, but continuous control of the chemical conditions existing in the boiler water and adjustment of these conditions by alterations in the quantity of treatment added or, if necessary, by adjustments in the proportions of the various chemicals present in the chosen combination.

In general, the special requirements of any method of "internal treatment" can be summarized as follows:

(*a*) The chemicals used should have no harmful effects on boiler metal, boiler fittings, &c., nor should they be unduly dangerous to handle.
(*b*) If desired it must be possible to feed the chemicals through feed lines, economizers, &c., without fear of causing choking.
(*c*) There should be no priming effect from the chemicals used.
(*d*) The chemicals chosen must be such that effective control of the conditions in the boiler water can be maintained by interpreting results obtained by simple chemical tests.

The choice of method of introducing into the boiler the chemicals required for "internal treatment" will naturally be influenced very largely by local conditions and by the nature of the boiler feed water. In very many cases, the method adopted is the simple one of adding the chemicals to the water at the boiler feed tank. The chemicals are normally added as solutions, and may be fed continuously or as "shots" or "slugs" at regular intervals. Sometimes the required combination of chemicals is briquetted and the briquettes dissolved in a simple solution pot coupled into the feed system at some convenient point. If the water passes directly and quickly to the boiler, then the choice of treatment is simple, but if there are heaters or economizers to be traversed, the rise in temperature will not only tend to precipitate the temporary hardness, but will accelerate the reactions between the alkaline portion of the treatment and the permanent hardness which may cause precipitation and deposits in the feed system. By the use of certain inhibitors, which may be either organic or inorganic in nature, it is possible to delay this precipitation until such time as the water arrives in the boiler, but obviously there are limitations to such a method. This is particularly true if the water is one which is naturally unstable and therefore will incrust pipe lines, &c., even in the cold. In such cases it is essential to divide the treatment into two parts, one to keep the feed system free from scale and corrosion, the second to prevent scale in the boilers themselves. This involves feeding the first part of the treatment at the hot well, and the second part either into the feed line immediately before the boilers or directly into individual boilers. In large installations individual feeding directly into the boilers is often an advantage, no matter what type of water is in use, as it ensures that every boiler receives its correct treatment.

Having ensured that the correct chemicals for any particular water are used and that these have been introduced into the boilers and the right type of sludge produced, it then remains to remove this sludge from the boiler, together with the corresponding dissolved solids present in the boiler water. It is well known that, even in the absence of suspended solids, the dissolved solids in a boiler water cannot be concentrated indefinitely, otherwise a point is reached at which foaming takes place and boiler water is carried over with the steam, and may cause trouble in steam engines, turbines, or in process working. This tendency to priming is aggravated by the presence of finely divided suspended solids, such as would result in a boiler water from the use of alkali alone, without any means of conditioning the sludge so produced. Coagulation of the solids in the manner already indicated increases the particle size, which in turn decreases the effect in causing priming and foaming. Also, by proper conditioning, the sludge is made non-adherent and is spread evenly throughout the boiler water, so that when the boiler is blown down the suspended solids are removed in proportion to the amount of water removed from the boiler. Therefore, by the use of either continuous or intermittent blowdown, properly controlled, the hardness precipitated in the boiler can be easily removed and prevented from accumulating.

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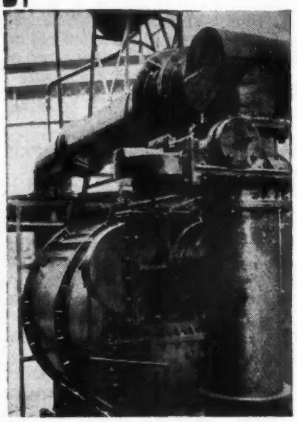

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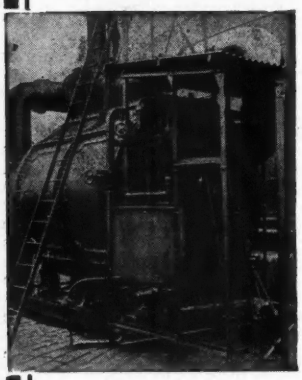

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Gas Products Prices

The London Market Dec. 14.

The only item of interest in connexion with the London Coal Tar Products market is that fair quantities of Pitch are being sold on the basis of 45s. per ton naked at Makers' Works. Otherwise no change.

The Provinces Dec. 14.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 10d., pure, 2s. 5d. (controlled by the Control of Toluene No. 2 Order, July 3, 1941, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 1s. to 1s. 4d. according to quality. Solvent naphtha, naked, North, 2s. 2d. to 2s. 6d. Heavy naphtha, North, 1s. 10d. to 1s. 11d. Carbolic acid, 60's, controlled by the Coal Tar Acids Prices (Inland) Order, 1942, operative from May 1. Naphthalene, controlled by the Naphthalene prices (Inland) Order, 1942, dated April 15, 1942, and operative from May 1, 1942, £19 to £19 10s.—bags free. Anthracene, controlled by the Anthracene Prices (Inland) Order, 1942, operative from May 1. Filtered heavy oil (min. gr. 1,080), 7½d. to 8d. Creosote oil has been generally controlled as to direction and price for some time past. Current value—fuel grades 5d. to 5¼d; timber preservation and other purposes 4¾d. to 6d. These prices apply as from May 13.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Tar Products in Scotland Dec. 12.

Demand continues strong with production well maintained. Refined tar controlled. Value is 4½d. per gallon *ex* Works, naked. Creosote oil: Specification oil, 6½d. to 7d.; low gravity, 7¼d. to 7½d.; neutral oil, 6¾d. to 7d. per gallon; all *ex* Works in bulk. Refined cresylic acid is changing hands in limited quantities at 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha: 6½d. to 7d. Solvent naphtha: 90/160 grade, 2s. 5d. to 2s. 6d., and 90/190 Heavy naphtha, 1s. 11d. to 2s. per gallon. Pyridine: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

Gas Stocks and Shares

Conditions in the stock market were quiet generally throughout the whole of last week, although a few bright spots appeared in the industrial section towards the close and some home rail stocks were in demand. The tone, however, remained firm. Gas stocks and shares were in fair demand, and it will be seen that with the exception of a drop of 9d. in Gas Light units, which, it will be remembered, had made rapid progress for some weeks past, a number of issues recorded further small gains. A feature on the Provincial Exchanges was a rise of 3½ points in Chester ordinary after a long period at the previous price of 97½. This company has distributed an ordinary dividend of 5¾% for many years past, and the current price is still somewhat on the low side having regard to the values of similar class stocks of other provincial undertakings.

The following quotations were changed during the week:

OFFICIAL LIST		
Barnet Ord.	135—140	+2
British Ord.	78—83	+1
Commercial Ord.	55—60	+2
Ditto 3 p.c. Deb. (*x.d.*)	60—65	Dec. 7
Gas Light Units	16/3—17/3	—/9d.
Ditto 3½ p.c. max.	61—65	+½
Imperial Continental	81—86	+1
Montevideo Ord.	92—97	+2
Plymouth & Stonehaven Ord.	67—72	+2
South Metropolitan Ord.	74—79	+1
Tottenham Ord.	93—98	+1
Ditto 4 p.c. Deb. (*x.d.*)	98—101	Dec. 7
United Kingdom Ord.	18/—19/-	—
Ditto 3½ p.c. Red. Deb.	92—97	+2
SUPPLEMENTARY LIST		
Slough 5 p.c. Deb. (*x.d.*)	110—115	Dec. 7
Uxbridge 5 p.c. Deb. (*x.d.*)	115—120	"
PROVINCIAL EXCHANGE		
Chester Ord.	100—102	+3½

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GAS JOURNAL, DEC. 23, 1942

VOL. 240 94th YEAR No. 4153

EDITORIAL NOTES

COAL CONSERVATION

WE are glad to be able to record in our penultimate issue of 1942 an Address of no little importance and significance which the President of The Institution of Gas Engineers gave last week in London to the Fuel Luncheon Club before a notable gathering widely representative of the fuel industries. Mr. Evans has always been an ardent worker for the Gas Industry, and in his capacity as Institution President at a critical period in the Industry's history he has spared himself no pains in shouldering additional tasks; and we would mention that apart from the outstanding Addresses which we have published —of which this is the latest—he has given several private talks to gas associations throughout the country, taking into his confidence the younger members of the Industry. The influence of all this work cannot be other than helpful at a time when opportunity would seem to present itself for effective planning on a co-operative basis among all the fuel interests under the aegis of the Ministry of Fuel and Power. Much will depend on whether the opportunity is grasped. Actually Mr. Evans confessed that he could see few signs of the industries themselves preparing for a comprehensive scheme of co-operation in service. It is difficult to imagine that the respective spheres of action will be defined by any body of fuel experts. "Co-ordination of our efforts," he remarked, "will only be achieved by the findings of impartial judgment sifting and balancing the advice of experts." He did not urge that the Gas Industry of the future should be given a place that its achievements and potentialities do not justify. But a great deal of money will be saved and the expenditure of much useless effort avoided if we can agree to proceed under a sane national fuel policy. Hence his plea for a full enquiry by competent and completely impartial judges into the present state of fuel technology and the most appropriate lines for future development in the light of the conservation of coal, the restoration of our national economic structure, and the health and comfort of our people.

Prior to the last war our national prosperity was primarily won on coal, but during the period between that and the present war the world industrial picture changed; increasingly other countries manufactured goods with which formerly they were supplied by Great Britain—and considering the future we must bear in mind that the coal deposits of this country, on which our premier position in the early part of this century was based, represent less than 5% of the world's resources. The importance of coal conservation cannot be overstressed. The Gas Industry has done a good deal towards coal conservation. The gradual replacement of the coal range by the gas cooker has in fact meant a saving of coal to the extent of some 15 million tons a year. But fuel used for cooking, as we have emphasized, represents only about one-fifth of the total heat required by the domestic user. The greater part of the remainder involves the burning of raw coal. The problem lies in the extent to which the Gas Industry could economically supplant raw coal, and this involves some working understanding with the electricity industry. This understanding calls for investigation, and Mr. Evans set out some of the factors which ought to be taken into account—all with the aim of conserving coal.

On the very day that Mr. Evans discussed this vital question of coal conservation Sir Evan Williams gave his Presidential Address to the British Coal Utilization Research Association, in which he announced a five-year £1,000,000 scheme of coal research—by far the largest co-operative research scheme ever undertaken in this country for the development of an industrial asset. The Department of Scientific and Industrial Research has undertaken to contribute £50,000 a year to the cost, and £250,000 over the five years. The Mining Association will contribute £80,000 a year and £400,000 altogether, and the balance of £70,000 a year will be provided by associations of manufacturers who make plant and equipment for using coal. The production of liquid fuels is one of the aims of the research; another is the more efficient generation of electricity. And we learn that there is ready for mass production an open firegrate in which the same amount of heat comfort can be obtained from half the consumption of coal. We learn, too, that the Post-War Directorate of the Ministry of Planning has asked the Coal Utilization Research Association to carry forward to the production stage appliances of this kind so that they may be procurable for the post-war house building programme. We do not discern in the scheme any expressed views on collaboration with the Gas Industry in the preparation of smokeless fuels or of their place in the "things to come." But the scheme is a bold one, the very boldness of which commands respect. It has been described by *The Times* as a "wise and, it must be hoped, exemplary assertion of the saving power of research," and the national Press generally has hailed the enterprise with gratification.

Then, on the same day last week that we received news that a Town Council in Aberdeenshire had decided to ask the authority of the Ministry of Fuel to allow those in its area who desired to do so to install electricity instead of gas, on the grounds that the local gas company could not supply the demand for gas and had imposed restrictions on its use, the report was issued of the Committee on Hydro-Electric Development in Scotland, appointed in October, 1941, to consider the practicability of the development of water power for the generation of electricity. The Committee recommends the creation of a new public service corporation called the North Scotland Hydro-Electric Board, which will be responsible for initiating and undertaking the development of all further generation of electricity in the northern area for public supply, and its transmission and supply in bulk to the existing undertakers. Also, it should further be responsible for generation, transmission, and distribution in all areas outside the limits of existing undertakers. Among the primary objectives of the programme of the Board, it is urged, should be to develop such power as may be required for the consumers of existing undertakers or for consumers in its own distribution area, the surplus being exported to the grid, and to develop on an experimental and demonstrational basis isolated schemes in isolated areas. Here again we have bold recommendations, and it seems probable that the long-term technical scheme will involve the construction of high-tension transmission lines connecting with the Grampian at Aviemore, proceeding *via* Inverness and Easter Ross district, thence *via* the Lochaber district and the Argyllshire and West Perthshire developments to connect up with the grid in the neighbourhood of Glasgow. Another loop would proceed eastwards to Aberdeen. It is contemplated that the Act which will bring the Board into being will, in outline, authorize once and for all the scheme of development to be undertaken; and it is recommended that provision should be made for exemption from rates of the proposed new schemes either permanently or for a prolonged development period.

We approach the end of the year in the knowledge that the coal industry and the electricity industry are moving ahead in a concrete way and are thinking and planning and acting in a very big way. How will the Gas Industry stand *vis-a-vis* these developments?

EDUCATION

WHATEVER the changes, behind all stands the basic need for the Industry to attract to its ranks the right type of men. This is not a new theme, but it seems to us to assume not less but more importance, and it is a problem which must be tackled with both vigour and imagination. Rightly, it is being discussed. Only this month we referred to the argument that the educational standards of the Institution are not high enough, pointing out that neither are the salaries offered by the Industry. We think we have to face the fact that the Gas Industry is not attractive to the student, and that the chemist who leaves his university to enter chemical industry with its sensational developments in catalytic processes, the production of plastics, and so on, looks forward to a more interesting career than his fellow student who enters in rather lukewarm fashion the Gas Industry. On the scientific side it may be doubted whether the Industry is getting a proper share of men of right calibre. The question was put last month whether the Industry had developed a type of personnel curiously impervious to new ideas, and the suggestion was made that efforts should be made to have about 20% of our works engineers and other responsible officers below the age of 30. Another suggestion was that we should increase the status of our technical officers and include among them foremen, some of whom are undoubtedly gifted with great innate ability. Their reliability and command of their job is considerable and they are capable of undertaking more responsibility; promotion to a higher grade would benefit the individual, and it would at the same time encourage and stimulate those working under him.

Another recent comment was to the effect that the most disturbing feature about the present system of education and the worst accusation that can be levelled against it lies in the truth of Professor Laski's definition of education as "the art which teaches men to be deceived by the printed word"—in one word, gullibility. That the present system turns out a vast majority who are unable or unwilling to think and reason for themselves or to decide whether there is a reasonable probability that a proposition is true—a vast majority which takes things for granted, which is not endowed with an enquiring mind, which appears to have a sense of values shockingly out of proportion. On a more optimistic note another speaker at a recent Gas Industry meeting—one who has had long experience on what we may term the practical scientific side—expressed the view that present-day recruits from our educational institutions are mentally better equipped than their fathers. He queried, however, whether the Industry had adequately grasped the importance of continuity of education. An individual is in the hands of the professional educationist up to the age of, say, 16 to 21. He then enters the Gas Industry at an impressionable age, and much of his future usefulness depends on his early treatment and on the contacts made in his early years in the Industry. He should be made responsible to someone a few years senior, who in turn should be under the guidance of more experienced persons. In other words, let us appreciate this need for continuity, realizing that there are several stages of man's development after leaving school or the university.

The suggestions made could be multiplied, but fundamentally the question of education cannot be divorced from that of salaries. We do need a ready supply of trained men keen to employ their knowledge in the belief that their efforts will be rewarded. One cannot contemplate the future with any sense of equanimity without a flow of trained technicians into the Industry.

Fuel Economy and the Collieries

The day will come when it will be criminal to burn raw coal. This view was expressed by Mr. H. E. Partridge in a Paper this month to the Institute of Fuel on fuel economy at collieries. The fuel industry, he suggested, might be regarded as an agglomeration of collieries dealing with different classes of coal, and taking the solid by-products of gas-works and coke ovens, production below a certain quality could be effected through a number of blending plants, giving adequate fuels for steam raising which would be common within areas of probably 1,000 sq. miles. The result would be to the advantage of all concerned, because designers and manufacturers of combustion equipment would deal with more or less straight-line conditions. The operatives in all directions would also develop a common knowledge arising from a common experience, while the hardship on the separate collieries where the drug from the treatment plants has to be dealt with would be relieved of the problem of ultimate refuse which could be centralized and dealt with by adequate organizations.

Our new planning, he said, of which so much is written and far more spoken, should embody in its considerations the utilization of the heat which is going at present to warm the atmosphere, rivers, canals and the foreshores. It is with this in mind and with the reasonable anticipation that this matter will eventually be of general acceptance that the suggestion is made that colliery loads be taken by the central stations. Such a change over will occupy many years, but in taking the long view it would appear to be more desirable to extend the central stations which specialize on a certain product than to enlarge the 2,000-odd collieries which are becoming more and more overloaded. And, he concluded, "we are living in strenuous and serious days, when the future of the nation is being moulded; not the least of the impressions which will be retained is that which will be the outcome of our present approach to the national assets now belonging to the community."

Personal

The appointment of Mr. A. E. SYLVESTER as a Managing Director of the Gas Light and Coke Company has been announced. He has been connected with the Gas Industry for about ten years, and was appointed Comptroller of the Gas Light and Coke Company in 1934, and General Manager about a year ago. In addition to his membership on a number of Committees connected with the Gas Industry, Mr. Sylvester is Chairman of the London Regional Gas Centre, of the London District Executive Board, and of the Methods of Charge and Statistics Sub-Committee of the Post-War Planning Committee. He is Chairman of the Gas Industry Oil Committee recently set up by the Ministry of Fuel and Power. He is also Deputy Regional Fuel and Power Controller for the London area.

Mr. Sylvester brings to his new appointment a wide experience in other fields. He is a Chartered Accountant, and before he joined the Gas Light and Coke Company his professional duties took him to many countries in Europe. He has since travelled in America also. Mr. Sylvester is a great believer in delegation of authority, and in the last year or two has been responsible for considerable changes in the internal administration of the Company. He has divided the area into six Divisions, and made each Divisional Manager responsible for the commercial activities in his own Division. A problem to which Mr. Sylvester has devoted much attention is the post-war position of men at present serving in the Forces. He regards it as vitally important that their careers shall not be prejudiced because of the active part they are playing in the war.

* * *

The personnel of the National Coal Board was announced last week. As recorded in our report of this month's meeting of the Central Executive Board of the National Gas Council in our issue of Dec. 16, Mr. S. TAGG, J.P., has been appointed by the Minister of Fuel to represent the Council on the new Board.

* * *

It was announced at the annual meeting of the East Surrey Gas Company Co-partners that Mr. W. LEES STENNING had resigned from the Chairmanship of the Company and the Co-partnership Committee and that Mr. W. H. BENNETT had been elected to these offices. Mr. Bennett joined the Company as Chief Engineer 32 years ago. He was appointed Managing Director in 1917 and later Deputy-Chairman of the Board. He is Chairman of Associated Gas and Water Undertakings, Ltd.

* * *

It is now known that Mr. C. HALES-FINCH, a Southern representative of John Wright & Co., Ltd., is a prisoner of war in Japanese hands. He was last seen alive at the fall of Singapore, and his many friends will be pleased to hear of his safety.

* * *

Mr. and Mrs. WILLIAM RITCHIE, of Peterhead, have celebrated their golden wedding. Mr. Ritchie was formerly Gas Manager at Peterhead.

Mr. J. W. TOWNSEND, Engineer and Manager of the Sheppy Gas Company and the Sittingbourne District Gas Company, has been appointed Engineer and General Manager of the Tunbridge Wells Gas Company in succession to the late Mr. L. J. Langford.

Mr. G. H. KENYON, Assistant Engineer and Manager of the Lea Bridge District Gas Company, has been appointed Engineer and Manager of the Sheppy and Sittingbourne Gas Companies in place of Mr. J. W. Townsend.

These changes will take place early in the New Year.

Obituary

The death has occurred of Mr. F. G. AMBLER, Representative of Messrs. Sawer & Purves, Manchester.

* * *

Members of the Gas Salesmen's Circle in the South-East of England will learn, with regret, of the death of WILLIAM R. MOFFAT, of Dover, who died suddenly this month within a short period of his retirement. A correspondent writes in appreciation as follows: "Of dignified bearing and pleasing manner, he had much of the old-world courtliness and charm, and was known to a large number of the inhabitants of Dover, where, in his capacity of Showroom Manager to the Dover Gas Company, he rendered valuable and faithful service for so many years. Moffat would have been the first to deny that he had any special attributes which fitted him for the hazardous life of a "front line" town, but as "courage mounteth with occasion," he found his niche and set an example of quiet fortitude and endurance which will be remembered by all with whom he came in contact during those last exciting years."

Letter to the Editor

The Critical Air Blast

SIR,—It appears from the recent Paper on the Critical Air Blast, by Messrs. Bangham and Phillpotts, and the discussion of that Paper at a meeting of the Institute of Fuel, that the apparatus dealt with is to become the subject of a British Standards Specification.

I would suggest that before this is done the sponsors of the apparatus should be called upon to "lay their cards on the table." Those who have read the Paper may have observed that a number of tables were devoted to showing how, with fuels such as coke, semi-coke, anthracite, and activated coke, it was extremely difficult to secure consistent and comparable results in different laboratories with this piece of apparatus. The Authors did, however, include a table which was intended to show that concordant results could be obtained, but in view of the fact that we were not told what kinds of fuel did give consistent results the question of the universal applicability of this apparatus is still hanging in mid-air.

The position at present is that we know that when using gas coke, oven coke, semi-coke, anthracite, and activated coke, divergencies amounting to 45% can be obtained in different laboratories. We also know that with fuels "A," "B," "C," "D," and "E" results can be obtained within a reasonable degree of agreement. My view is that this latter piece of information is of very little value. What we do *not* know is whether concordant results can be obtained with the fuels which I have enumerated, and in which fuel technologists generally are interested.

It is to be hoped that the British Standards Institution will not launch a specification in which the really essential information required to give us confidence in the apparatus is withheld.

Oakfield, The Park, Cheltenham. Dec. 19, 1942.

Yours faithfully,
JOHN ROBERTS.

Institution of Gas Engineers

The Council of The Institution of Gas Engineers met in London on Dec. 8. The following were some of the matters dealt with:

The deaths of four members of the Institution were reported: Mr. R. W. Hunter (Wroxham), a former Vice-President; Mr. L. J. Langford (Tunbridge Wells), a former member of Council; Mr. George Airth (Dundalk), a member of the Gas Education Committee; and Mr. C. R. Blogg (Kingston-on-Thames) on active service.

As a result of the Autumn Ballot, 2 members, 27 Associate Members, and 1 Associate were elected to membership of the Institution. The list of names is as follows:

Membership.—Forshaw, A., R. and A. Main, Ltd.; Hazeldon, J. N., Regional Gas Liaison Officer, Ministry of Fuel and Power.

Associate Membership.—Beaumont, F., Meltham Gas Department; Bruce, R. D., Tottenham and District Gas Company; Castell, A. H., Gas Light and Coke Company; Clark, W., Middlesbrough Gas Department; Crossley, F., Stroud Gas Light and Coke Company; Daniels, F. R., Warrington Gas Department; Edwards, C. H., Evesham Gas Department; Goldsmith, F. G., Gas Light and Coke Company; Goodale, A. A., Gas Light and Coke Company; Gregory, J. R., Oswaldtwistle Gas Department; Heasman, H. V., Croydon Gas Company; Higgs, A., Yorkshire Industrial Gas Development Centre; Jones, C. B., Neath Gas Department; Kay, W. H., Newark Gas Department; Langford, R. G., Croydon Gas Company; Nicholson, T. A., Weston-super-Mare and District Gas Company; Ormerod, S. P., Bridlington Gas Company; Plimsoll, J. H., Burton-on-Trent Gas Department; Rhodes, W., Weston-super-Mare and District Gas Company; Rolls, C. G. S., Radiation Limited; Rouse, D. H., Gas Light and Coke Company; Scattergood, W. H., Cortonwood Colliery, Coking, and By-Product Company, Ltd.; Stewart, W. C., Wolverhampton Gas Company; Stubbs, J. A., Walsall Gas Department; West, A. E., Coventry Gas Department; Westbrook, G. A., Gas Light and Coke Company; Wilson, F., Middlesbrough Gas Department.

Associateship.—Jamieson, C. W., Regional Gas Liaison Officer, Ministry of Fuel and Power.

It was decided not to award the Birmingham Medal, the Institution Gold Medal, and the H. E. Jones London Medal for 1942. The Affiliated District Gas Associations and the Junior Gas Associations will be invited to submit Papers, as usual, for the award of the Institution Silver Medal, 1942, and the Institution Bronze Medal, 1942, respectively.

A report was made on the progress of the setting up in the various Civil Defence Regions of Gas Engineering Advisory Boards. It was decided to arrange an early meeting of the Co-ordinating Committee of the Advisory Boards (comprising the Chairman and Secretary of each Board) to discuss with the General Purposes Committee of the Council of the Institution and with the Director-General of Gas Supply (Dr. E. W. Smith) the terms of reference, scope, and details of operation of the Boards.

The despatch to all gas undertakings was reported of a memorandum on a Scheme of Precautions against Frost on a Gas-Works and, at the request of the Ministry of Fuel and Power, of a memorandum on Fires at Gas-Works and in Gas Mains.

A report was made by the Acting Director of Research on the progress of the current investigations of the Gas Research Board.

Reports were made of meetings of the Post-War Planning Committee and of its Sub-Committees.

It was reported that (*a*) the first Draft Report of the Gas Installations Committee had been sent to the Ministry of Works and Planning on Nov. 2. Copies of the Report have also been sent to the affiliated District Gas Associations in order to obtain the views of the Districts on the recommendations made by the Committee; (*b*) the Institution have accepted an invitation to be represented on the Codes of Practice Committee of the Directorate of Post-War Building.

It was decided that, circumstances permitting, arrangements should be made to hold the 80th Annual General Meeting, restricted to one day, in London, in June, 1943.

British Standards Institution

The range of British Standards is now so diverse, and the number of war emergency issues is so large, that no printed list of standards can be up-to-date.

The latest information regarding the issue of new and revised British Standards, of which there are at present over a thousand, can be obtained from the B.S.I. Library at 28, Victoria Street, Westminster. These standards may be studied in the Library between the hours of 10 a.m. and 5 p.m., Mondays to Fridays, and at other times by appointment.

The B.S.I. Library also contains a large selection of specifications prepared by the standards bodies in Australia, New Zealand, South Africa, Canada, U.S.A., Argentine, Sweden, France, Germany, &c. Extracts from specifications may be made, if desired, and copies of the overseas specifications may be borrowed.

The following Libraries, Colleges, &c., maintain a complete set of British Standards:

London—British Museum, City & Guilds Engineering College, King's College, Science Library (Science Museum), University College.
Glasgow—Glasgow University, Royal Technical College, Mitchell Library.
Edinburgh—Edinburgh University, National Library of Scotland.
Cambridge—Cambridge University (Engineering Laboratory), University Library.
Oxford—Bodleian Library.
Nottingham—University College, Central Public Reference Library.
Newcastle on Tyne—Armstrong College, Central Public Reference Library.
Birmingham—Municipal Technical School, Central Public Reference Library.
Leeds—University of Leeds, Central Public Reference Library.
Manchester—Victoria University, Central Public Reference Library, College of Technology.
Dublin—Trinity College.
Aberystwyth—National Library of Wales.
Cardiff—Central Public Reference Library.
Middlesbrough—Central Public Reference Library.
Sheffield—Central Public Reference Library.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

THE GAS INDUSTRY AND COAL CONSERVATION*

By

E. V. EVANS, O.B.E.,

President of The Institution of Gas Engineers.

IT is one of the difficulties associated with planning for the future that most of the planners, by virtue of their age, cannot hope to live in the promised land that they have planned. This may, of course, have its compensations, for while they cannot expect to enjoy the fruits of their wisdom, neither will they have to suffer the penalty of their folly. It is not a light matter to live in the present day, when decisions now taken will influence profoundly the society in which future generations shall live. And we shall receive and deserve the condemnation of those future generations if, by undue concern for our short term interests, our personal predilections, or the ephemeral issues of competitive commerce, we leave a tangled technology or a shallow system of national economy.

It is by no means easy to take an impersonal or impartial view of matters which have been one's daily interest for many years, but I am convinced, after studying the technical and economic facts in as judicial and impartial a manner as I can, that in the processing of coal by carbonization to gas and coke and other products lies very great possibilities indeed for the betterment of the nation. I do not seek to convince you of my arguments for a greatly extended Gas Industry, and I shall be content if what I have to say helps to accentuate the necessity of a full enquiry by competent and completely impartial judges into the present state of fuel technology, and the most appropriate lines for future development in the light of the conservation of coal, the restoration of our national economic structure, and the health and comfort of our people.

A Matter of Significance

The institution of a Ministry of Fuel and Power which covers all branches of the fuel industry, and is staffed by able technicians as well as experienced State officials, is a matter of great significance as well as being one of great satisfaction to us all. No less pleasing is it to know that the work of the Research Organizations serving the fuel industries is to be co-ordinated under the aegis of the Department of Scientific and Industrial Research. It may be said that the stage is set for the institution of a comprehensive national fuel policy, but the policy to be adopted requires definition.

In order to emphasize the urgency of the enquiry into the problem of the conservation of coal, will you allow me to give brief consideration to the past. Our economic prosperity in the earlier part of this present century was derived from the lead we had gained over other nations in the production of iron and steel and the fabrication of plant, machinery, and appliances (tools) from these metals. Power-operated machines made from iron and steel enabled us to manufacture and sell abroad numerous goods such as textiles. Other machines and steel structures we exported to countries needing them. Ships made of steel and driven by coal carried these goods all over the world, and we were able to purchase not only food and other necessities and amenities of life, but also raw materials for industry. Further, we invested large sums of money in other countries, thereby achieving a premier position in commerce, banking, and finance. None of these things would have been possible if this country had not possessed rich and easily worked deposits of coal, and it may be said truly that the prosperity of Great Britain was based fundamentally upon the winning of coal, and the acquired skill of her people in using this coal and the articles and materials associated with it.

The war of 1914–18 modified the position considerably, depriving us of many of the advantages we possessed by having been first in the field. Other countries expanded their production of coal and of goods that could be made with its aid. Petroleum advanced rapidly as a rival to coal for the production of power. To pay for war-promoting articles purchased abroad many of our overseas investments were sacrificed. The period between the two wars became one of great difficulty with evidence of economic instability.

What the war of 1914–18 commenced, the present war is likely to complete. Many countries, including the Dominions, have built great industrial plants capable of supplying a very large part of the manufactured goods they require. Our overseas resources have shrunk to relatively small dimensions, and the problem for Great Britain after this war will be how we can maintain an economic prosperity that will place us, in relation to other nations, in the position we deserve to occupy. If our coal resources were unique or if they represented the major part of the world's coal resources the position would be easier, but the coal deposits of this country represent less than 5% of the world's resources. The importance of coal conservation can hardly be overstressed. Already it is becoming more difficult and more costly to win the coal of this country, and as reserves are further depleted this tendency must become more pronounced. The maintenance of a reasonable level of economic security and stability will require that the resources of material and man power in Great Britain shall be used with the utmost efficiency, and that waste in every form must be avoided.

Advances in the Fuel Industry

Since the last war considerable advance has been made by all branches of the fuel industry in the matter of better utilization of fuel. In the generation of power in the form of electrical energy the advance has been phenomenal. In 1916 the consumption of coal per h.p. hour was estimated as 5 to 7 lb., and the figure for power obtained through the electricity distribution system just prior to the present war was less than 1¼ lb. of coal. In 1938 it had been reduced to 1½ lb. The Gas Industry has increased the thermal efficiency of its process to about 80%, and the total amount of heat supplied from gas undertakings increased 13% (1920–1938).

The incentive to progress arose partly out of the recommendations of the Coal Conservation Committee formed in 1916, but the Committee concerned itself mainly with large individual units consuming coal—namely, the iron and steel industries and power consumers. The Gas Industry, however, is and has been concerned mainly with the smaller users of fuel, who nevertheless in the aggregate represent as much as 35–40% of the coal consumed in the country.

It is particularly for the benefit of the smaller fuel user that a rational fuel policy is now required. Large industrial undertakings can and do employ fuel technologists to advise on their fuel requirements and the best way of meeting them. If the fuel requirements of the smaller industrial and commercial users, and most particularly the private domestic user, are to be met efficiently and economically, some measure of guidance is necessary.

Let us consider some aspects of the question—aspects as seen from my personal viewpoint—which may demonstrate not only the urgency of the problem, but also its great complexity.

The Gas Industry to-day supplies the greater part of the fuel used for cooking in the houses of this country. The replacement of the coal range has been gradual and has become accepted as a natural development. Unspectacular though this replacement may have seemed to be, it has nevertheless meant the saving of coal to the extent of some 15 million tons a year, and an enormous relief to the housewife. Yet the fuel required for cooking forms only about one-fifth of the total heat required by the domestic user. A small part of the remainder is supplied by electricity, but the greater part still involves the inefficient use of raw coal.

By the use of the word "inefficient" I refer not only to the low thermal efficiency characteristic of the open coal fire, but to the general inefficiency that makes the coming of winter and the additional work and dirt of fires a recurrent threat to the smooth working of any house.

In planning for the future the coal industry is endeavouring to design appliances that shall burn coal smokelessly; the Gas Industry is preparing to demonstrate how greatly the interests of the nation and the consumer will be served by the extended use of gas for space heating and water heating, and the electrical industry, it is believed, is interested to take over such a proportion of these loads as can be supplied remuneratively.

It is never an easy matter to choose the best of a number of alternatives, but the choice becomes extremely difficult when each alternative involves the consideration of so many factors.

Choice between Alternatives

We must include coal conservation as one of the predominant factors. Appliances and methods that were in common use before the war, and are in use to-day, show striking differences in the amount of coal that had to be consumed to give equivalent service by different methods. For most domestic uses gaseous fuel showed a saving of some 40% compared with either raw coal or electricity. And in the use of all these fuels there was room for further improvement.

Transport and delivery of solid fuel and the collection of ashes are also important factors. Rubber, petrol, and manpower are scarce now, and however plentiful they may become, they should not be employed wastefully.

At last there are signs that the public conscience, and indeed the official conscience, is becoming disturbed at the extent of damage caused by atmospheric pollution—pollution caused not so much by industry as by the domestic user of fuel.

Another matter requiring careful study is the intermittency of fuel demands by various classes of consumers. That is, the effect of load factor on cost of supply. Almost none requires fuel to be supplied at a uniformly steady rate throughout the year, but there are few classes that show a more intermittent and varying demand than the domestic consumer. The Gas Industry knows that the domestic cooking load represents an hourly load factor of only some 17 to 20%. This is to say that mains and services are only used to deliver one-fifth to

* An Address to the Fuel Luncheon Club, Dec. 17.

one-sixth of the gas that they would supply if they operated continuously at maximum load. Fortunately, the ability to store gas makes it possible to even out the load on manufacturing plant so that the plant operates at a load factor of over 60%. Experience indicotes also, I may add, that the exclusive use of gas for all domestic heating results in an annual load factor of about 50%—a state of affairs that can exist without undue capital and other overhead costs.

The fact that electricity cannot be stored makes a good load factor of great importance in ensuring a supply of cheap electricity. Demands for lighting and power represent a load factor of perhaps 30 to 33%. Collaboration between gas and electricity undertakings aiming at the use of "off peak" electricity loads for such purposes as water heating is a matter requiring investigation. Such co-operation in sales policy might well raise the above figure to 50% and lead to an appreciable reduction in the cost of current, but great care would have to be taken to ensure that one industry, by virtue of the nature of the new loads taken by it, was not hampering the development of the other.

Price structure for the sale of gas and electricity needs extensive overhauling. While it will probably remain true that each industry will have to carry a proportion of consumers who do not contribute their full share of the costs of supply, every effort should be made to see that this proportion is kept as small as possible and does not become a heavy burden on other consumers. There is no justification for price structures that put a tax upon consumers who must use the commodity in order to subsidize adventures in markets that, in themselves, are uneconomic.

This is not an appropriate occasion for me to state what the Gas Industry can do to aid the solution of these unsolved and inter-related problems. That I have done elsewhere.

It has been said that the various branches of the fuel industry should become complementary parts of one whole. That I believe to be highly desirable, but I see little signs of the industries themselves preparing for such a comprehensive scheme of co-operation in service. It is difficult to imagine that the respective spheres of action will be defined by any body of fuel experts. Co-ordination of our efforts will only be achieved by the findings of impartial judgment sifting and balancing the advice of experts.

In conclusion, I want to make it clearly understood that I am not here to urge that the Gas Industry of the future should be given a place that its achievements and potentialities do not justify. Still less am I pleading for the Gas Industry, for that Industry is full of confidence in its ability to render yet greater service in the future. My point is that a great deal of money will be saved, and the expenditure of much useless effort avoided, if we can agree to proceed under a sane national fuel policy. The framing and operation of such a policy I consider to be one of the essential factors leading to the recovery of our national prosperity.

GAS AND THE DESIGN OF DWELLINGS

The British Gas Federation has submitted a Report to the Design of Dwellings Sub-Committee of the Central Housing Advisory Committee of the Ministry of Health upon the contribution the Gas Industry is preparing to make to the improvement of housing conditions after the war.

The report states that careful planning of the services and appliances intended for fuel supply is of major importance in building design, and that it believes that every home built after this war can be provided with smokeless heating, hot water on tap, thermostatically controlled cooking, and refrigeration for food storage, and that these services can be provided without disproportionate increase in initial costs and at running costs favourable to the tenants. The following extracts are taken from the report.

(1) *Availability.*—Too often tenants have been expected to be satisfied with a single coal-burning appliance for heating the living room, cooking, and water heating, all of which functions will usually be required at different times. Gas or electricity provides each and all of these services at will, and furthermore provides means of heating at least one bedroom, which is essential for illness. However, it is a costly matter to carry out alterations and additions once a house is built. A well equipped house should give all normal services without the necessity to hire or purchase additional apparatus.

(2) *Flexibility.*—The degree of cleanliness and comfort required by different families varies so much that an average total fuel requirement cannot be assessed, but since there is normally a limited amount of money available for heat purposes, it is important to see that ample service is obtainable so that it may be used in any direction as desired by each family.

(3) *Cleanliness.*—If the educative value of re-housing is to be utilized to the full it is necessary for each new home to be easy to maintain. In this respect the kitchen is the most important room, since it is the workroom of the housewife and sets the standard of cleanliness, in addition to being the place where food is prepared and cooked. Gas appliances have improved kitchen conditions chiefly by making possible the separation of the working kitchen from the living room. Cleaner fuels make the cleanliness of the other parts of the house both possible and easy.

The services of fuel in the home must be considered separately.

(*a*) *Lighting.*—Generally speaking, electricity will be used for lighting in future housing, also for small power purposes.

(*b*) *Cooking.*—A fuel of high flexibility is required and it is estimated that there are now 9 million gas cookers and 1 million electric cookers in Great Britain. In London 90% of families use gas, although coal ranges had originally been installed in most houses. Experience has shown that gas cookers are used for many purposes, such as water heating, iron heating, &c., and it is therefore suggested that appliances of ample capacity should be provided in future.

(*c*) *Hot Water.*—This has been neglected in the past. Hot water is needed for personal ablutions, washing dishes, laundry and house cleaning. The usage varies so much that equipment should be provided to give ample supplies, yet not involve the small user in expenditure for hot water that is not required. Water heating demands are best met by gas, since it is peculiarly suited to provide large quantities of heat at a high rate of liberation for as long or short a period as desired. To supply irregular intermittent demands in large or small quantities the instantaneous type gas water heater is preferable either in the form of a multi-point heater to serve all taps or separate single point heaters. Where demands for hot water are less intermittent a gas-heated circulator, thermostatically controlled and combined with a lagged storage tank, offers advantages. In some cases a low consumption storage heater may be most appropriate. In larger households where some degree of central heating is desired, an independent coke-fired boiler compares favourably with a gas-fired system, but it is then desirable that an alternative gas-heated system be installed for use in summer months.

(*d*) *Laundry.*—The coal-fired copper has been replaced by a gas-fired water boiler in modern housing. Provision is also needed for drying and ironing. Some opinions advocate a clothes-drying room or closet as part of the structure of a house, but in the lowest income groups the additional fuel required would not be justified, and a garden or balcony for outdoor drying or a clothes airer in kitchen or bathroom is sufficient.

(*e*) *Living Room Space Heating.*—The preference in this country is for a glowing radiant fire for heating the living room. Attention has been given in recent years to the design of gas fires for continuous heating of rooms, as contrasted with types suitable for occasional use. But for the war designs would have been on the market which reproduced all the essentials and appearance of a coal fire. Educating the public away from coal fires will be slow, and it is advisable that a normal chimney breast be provided so that an open coke fire (with gas ignition) can be used as an alternative to a gas fire. It would be necessary to provide storage which could be used as cupboard space if solid fuel is not used.

(*f*) *Occasional Space Heating.*—This service is required for other parts of the house and is admirably met by gas. It is unnecessary to provide normal brick chimney breasts, as 12 in. by 2½ in. flues will suffice. In bedrooms the usual position of the fireplace in one wall is often inconvenient, being apt to scorch the bed in small rooms; a position across one corner is preferable. Flueless (portable) heaters are a suitable means of heating halls, bathrooms, &c.

(*g*) *Refrigeration.*—Before the war the cost of running a refrigerator was not high, but to most families the capital cost was the difficulty. If the appliance were installed as part of the house equipment, this cost could be considerably reduced.

(*h*) *Ventilation.*—Ventilation is influenced by the method of fuel used. A flue above an open fire is good. A degree of ventilation less than 600 or 700 cu.ft. per person per hour is not recommended. A room of 1,000 cu.ft. capacity requires 1.5 to 2.0 per hour air change for normal occupation. The normal gas fires perform this function. More attention must be given to kitchen ventilation.

Central heating is more likely to be successful in blocks of flats than district heating in housing estates, but fixed charge systems like central or district heating may be less popular than flexible systems which the user can regulate to suit his own pocket.

Up to the present tenants have borne the cost of appliances using modern labour-saving fuels, mainly because the cost of installing them in premises not designed for their reception is excessive. Future houses should have them included as an integral part of the structure.

Recommendations concerning all aspects of installation are being prepared by the Gas Installations Committee and by other Study Committees in collaboration with the Directorate of Post-War Building of the Ministry of Works and Planning. A gas supply should be available to each room where heating may be required. If the landlord were to accept responsibility for full fuel equipment, important advantages would accrue. Kitchen appliances could be constructed on a unit system so that, whatever choice of fuel was made by the incoming tenant, the appliances would be interchangeable.

Appendices are included of schedules of the appliances which would be considered necessary to give sufficient service, according to pre-war standards, for three grades of home—*i.e.*, "Minimum," "Normal," and "Special." Alternative schemes are also shown. Each appliance is designed, made, and purchased as a separate item without reference to a completed house, but it is hoped that architects, appliance manufacturers, and the supply industries can agree upon designs of wide application to enable better planned and more complete equipment to be provided.

A further three appendices show in diagrams suggested kitchen installations for each of the three grades, assuring greater co-operation as suggested above.

WORK OF THE GAS RESEARCH BOARD

EXTRACTS FROM THE THIRD ANNUAL REPORT OF THE COUNCIL

THE preparation of the Annual Report of the Council, which should be the vehicle whereby the members of the Gas Research Board are given a general review of the affairs of the Board, its membership, finances, deliberations, aims and achievements, and, more particularly, a summary of its investigations, becomes increasingly difficult under existing conditions. The fact that much of the investigatory work of the Board may not, in the national interest, be published during wartime, together with the restrictions on paper supply, combine to make such a Report a colourless and unsatisfying document. The Council, nevertheless, in spite of all the other abnormal demands made upon its members and the limitations of staff and facilities, has continued to meet regularly and to pursue the main lines of investigation which are briefly indicated later in this Report. It has very much in mind the desirability of extending its activities, as soon as ever circumstances permit, and of continually strengthening its contacts with the Gas Industry which it serves, and with kindred research organizations.

The research staff of the Gas Research Board at present comprises 3 research chemists, 1 research physicist, 7 research assistants, and 2 mechanics. The staff constitutes a skilled research team, which, while at present engaged on investigations of considerable importance, would be made available for any specific research work of still greater national urgency.

Dr. E. W. Smith, O.B.E., resigned from the Council in October, 1941, following his appointment as Director-General of Gas Supply. Mr. T. C. Finlayson, M.Sc.(Guildford), was appointed to fill the vacancy on the Council.

Although every gas undertaking which contributes at the standard rate to the funds of the National Gas Organizations is thereby eligible for Ordinary Membership of the Gas Research Board, there are still many undertakings that have not yet complied with the necessary formality of completing and returning to the Secretary a Form of Application. The Council particularly desires to include amongst the members of the Board every gas undertaking that is eligible for membership, and it hopes that those which, for one reason or another, have not yet made application will do so at the earliest moment.

The undertakings which are already members of the Board represent, however, about 77% of the gas made in the country. In addition, on the side of the Society of British Gas Industries, 61 firms of plant and appliance manufacturers are contributing members of the Board.

In regard to finance, a balance has been carried forward against the future requirements of more extended investigations and other activities and, in due course, of additional accommodation.

The 1st Annual General Meeting of the Gas Research Board was held at Gas Industry House on June 11. The business, which was mainly formal, included the election of the following Officers and Members of Council in the place of those due to retire, and of Auditors for the year 1942:

President, 1942–43: Sir David Milne-Watson, Bt., D.L., LL.D. (re-elected).

Vice-Presidents, 1942–43: George Dixon, B.Eng. (re-nominated by the Council of The Institution of Gas Engineers); Sir Frederick J. West, C.B.E., J.P. (re-nominated by the Council of the Society of British Gas Industries).

Members of Council, 1942–45: E. V. Evans, O.B.E., Stephen Lacey, B.Sc., Col. H. C. Smith, J.P. (re-appointed by the Council of The Institution of Gas Engineers); H. Hartley, D.Sc., Ernest West (re-appointed by the Council of the Society of British Gas Industries).

Auditors, 1942: Wood Drew & Co. (re-elected).

It was reported that the Council had re-elected Prof. D. T. A. Townend (Livesey Professor) to serve as a co-opted member of Council for the year 1942–43.

The 1st and 2nd Annual Reports of the Council of the Gas Research Board and the Accounts for the year 1941 were received and approved.

The Chairman, on behalf of the Council, has discussed with the Secretary of the Department of Scientific and Industrial Research the present and future position, policy, and scope of the Gas Research Board. The Council unanimously recommends that steps be taken immediately to obtain official association of the Board with the Department of Scientific and Industrial Research—a course which has always been visualized since the inception of the Board.

Review of Work

In addition to carrying on the research investigations referred to later in this Report, the Council has had under review and has collaborated with Government Departments in a number of technical matters of current or potential importance. These are briefly indicated below:

Coke for Portable Gas Producers.—Reference was made in previous Annual Reports to the investigation by the Gas Research Board, at the request of the Mines Department, of methods for the production at gas-works of reactive coke suitable as a fuel for portable gas producers. The practical investigation of this process is being pursued on the only coke activating plant of commercial size in this country, by one of the members of the Council of the Board, and the Council is thus kept in close touch with the latest development in the matter. The Gas Research Board is also represented on an advisory Committee of the Ministry of War Transport dealing with research on alternative fuels for motor vehicles.

Coke for Open Domestic Grates.—A note on the possibility of producing at gas-works alkali-activated coke sufficiently reactive to be suitable as a smokeless fuel for ordinary open domestic grates was included in the 2nd Annual Report. The Council considers that, whatever may be the ultimate application of such a fuel, it is essential for the Gas Research Board to be informed as completely as possible of the various methods available for producing coke of high reactivity and of the economics of such methods. The Council may find it desirable to undertake some practical investigations in this connexion, and the whole matter is being reviewed in consultation with other interested organizations.

Low-Grade Town Gas.—Several years ago research was carried out by the Gas Investigation Committee of The Institution of Gas Engineers on the relative efficiencies in use of different grades of gas (*c.f.*, 1st, 2nd, and 3rd Reports of the Gas Investigation Committee,* 1918–1920), and information has since then accumulated on special aspects of the comparative advantages and disadvantages of gas of various calorific values for town supply. The Council of the Gas Research Board has appointed a small Panel to review the whole subject.

New Processes.—The Council regards it as its duty, on behalf of the Gas Industry, to collect and review information regarding new processes affecting the Industry which are being investigated or developed in this and other countries. New processes to which such consideration has been given during the past year, without involving any practical investigatory work by the Board, concern, *inter alia*, the liquid purification of town gas, the production of gas from fuel of low rank, the carbonization of mixtures of coal and pitch, the production of reactive coke. A process which has been examined practically is referred to later.

Joint Research Committee of the Gas Research Board and Leeds University.

The membership of the Committee is:

Nominees of the Gas Research Board: E. V. Evans, O.B.E. (*Chairman*); H. Hollings, D.Sc.; Stephen Lacey, B.Sc.; Col. H. C. Smith, J.P.

Nominees of the University of Leeds: Prof. W. T. David, M.A., Sc.D., D.Sc.; Prof. M. G. Evans, D.Sc.; H. J. Hodsman, M.B.E., M.Sc.; Prof. D. T. A. Townend, D.Sc., Ph.D. (*Honorary Secretary*).

Honorary Member: Prof. J. W. Cobb, C.B.E, D.Sc.

Co-opted: Charles F. Botley; J. E. Davis; Harold Hartley, D.Sc.; F. O. Hawes; C. A. Masterman, M.A.; C. S. Shapley.

The Committee has to report the following changes in its membership during the past year: Col. H. C. Smith has resigned the Chairmanship of the Committee and Mr. E. V. Evans has been elected to serve as Chairman in his place.

Prof. J. W. Cobb has resigned his membership as one of the four representatives of the University of Leeds on the Committee and the University has appointed Prof. M. G. Evans, D.Sc., Professor of Physical Chemistry, to serve in his place. Prof. Cobb has been a member of the Committee from the time of his election to the Livesey Professorship in 1912, and he has acted as its Honorary Secretary for many years. As a mark of appreciation of his great and continued assistance to the Committee over this long period, the Council of the Gas Research Board has elected him as Honorary Member of the Committee. In this capacity he will be able to maintain his close connexion with the work of the Committee, in which he has always shown the keenest interest.

Dr. H. Hollings, who has served for many years as a co-opted member, has been elected one of the four representatives of the Gas Research Board on the Committee.

Reference was made in the 2nd Annual Report of the Council to a proposal for the erection of an exploratory plant for the purpose of transferring on to a larger scale the investigation of the hydrogenation and complete gasification of coal under pressure. The necessary permits to proceed with this project have been obtained, detailed plans have been drawn up, and the work is now progressing as rapidly as is possible under wartime conditions. Several gas undertakings and plant manufacturers are collaborating in this investigation by kindly making available to the Committee many of the items of apparatus required for the plant and by granting other special facilities.

It will be remembered that the object of this investigation is to examine the possibilities of a process whereby town gas of normal quality can be produced abundantly, with the maximum flexibility in

* *Trans. Inst. Gas. Eng.*, 1918–19, pp. 25 and 257; 1919–20, p. 167.

Release that VEHICLE !

IN the coming months transport is tackling the biggest job in its history. Lorries and wagons, canal-boats and ships must be working "all out" if the nation's transport system is to succeed. Great plans of organisation, improvements and new works have been carried through. The system *can* do its job — IF . . .

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You know your own problems best. Tackle them in your own way — But tackle them now. Plan, encourage ideas, improvise if needs be. Here's a starting-off agenda :

1. CHECK OFFICE ARRANGEMENTS
2. LABOUR-SAVING EQUIPMENT
3. BLACK-OUT WORKING
4. OPINIONS OF "MEN WHO DO THE WORK"

WE MUST GET AN EVEN QUICKER TURNROUND

Ministry of War Transport

the matter of the quantity of coke made and using a very much wider range of coals than can be used in existing carbonizing processes. The exploratory plant, while not necessarily bearing any close resemblance to the design of plant that might ultimately be proposed for large-scale operation, will enable the essential reactions of the process, which have appeared promising in the laboratory, to be studied on a semi-industrial scale.

While the preparations for this plant have been in progress, the investigation of the catalytic synthesis of methane has been actively continued both in the laboratory and in the two pilot units referred to in the previous Report. The influence of operating conditions, more particularly upon the performance and life of the catalyst, has been studied in detail, and the major difficulties that are met with in the catalytic treatment of water gas and synthesis gas have been successfully overcome. Results have been obtained in the laboratory in connexion with the catalytic removal of organic sulphur compounds from these gases and from town gas, which furnish valuable additional evidence on the important general problem of the removal of sulphur compounds from town gas.

The Committee has considered some of these developments worthy of provisional patent protection, since the synthesis of methane, either for use as a fuel or as an enricher of other gases, may have potential value for the Gas Industry and, indeed, in the national fuel economy.

Joint Committee on Methane Synthesis.

The membership of the Committee is:

E. V. Evans, O.B.E. (*Chairman*).

Nominees of the Joint Research Committee: Prof. J. W. Cobb, C.B.E., D.Sc.; H. Hollings, D.Sc.; Col. H. C. Smith, J.P.; Prof. D. T. A. Townend, D.Sc., Ph.D.

Nominees of the Fuel Research Board: Prof. A. C. G. Egerton, M.A., Sec. R.S.; Right Hon. the Viscount Falmouth; G. A. Hebden; F. S. Sinnatt, C.B., M.B.E., D.Sc., F.R.S.

This Committee has continued to meet regularly to review and advise upon the parallel investigations of methane synthesis which are being carried out by the Joint Research Committee and by the Fuel Research Board. The pooling of results and their joint discussion have contributed materially to the successful progress of these investigations.

Hydrogenation Sub-Committee.

The membership of the Committee is:

E. V. Evans, O.B.E. (*Chairman*); J. E. Davis; F. J. Dent, B.Sc., Ph.D.; T. C. Finlayson, M.Sc.; A. Key, D.Sc.; J. G. King, B.Sc., Ph.D.; P. G. G. Moon; Col. H. C. Smith, J.P.; Ernest West.

This Committee is responsible for preparing the detailed plans of the exploratory plant which is now well in hand and for the programme of the large-scale investigation of hydrogenation and complete gasification that will be carried out on this plant.

Refractory Materials Joint Committee.

The membership of the Committee is:

Nominees of the Gas Research Board: T. F. E. Rhead, M.Sc. (*Chairman*); T. Allen; F. H. Brooke; John L. Butler, M.B.E.; A. Edwards; P. C. Gardiner; W. T. Gardner; W. Grogono; C. R. F. Threlfall, M.C., M.A.

Nominees of the British Refractories Research Association: Col. C. W. Thomas; Frank West.

Ex officio: A. T. Green (Director of Research, British Refractories Research Association).

Co-opted: F. H. Clews, M.Sc.

The Committee has to report with regret the death on Feb. 19 of Mr. W. J. Gardner, who had been a member of the Committee for the past 16 years.

Regular meetings of the Committee have been held during the year and a visit of inspection to the Mellor Laboratories, Stoke-on-Trent, was made in June.

The testing service carried out by the British Refractories Research Association for the Gas Industry during the past year has proceeded normally. The Testing Committee of the Association, on which the Gas Research Board is represented, has continued to meet regularly. There has again been an increase in the amount of work undertaken on behalf of various Government Departments and Services.

In continuation of the series of investigations on the action of alkalis on refractory materials a cone-deformation study has been made of certain alkali-silica-alumina and alkali-silica-alumina-ferric oxide mixtures. This has been undertaken to supply information on these systems, which have so far been only partially explored by phase rule methods. The supplementary data obtained have enabled conclusions arrived at in earlier reports, on the conditions giving rise to softening or to embrittlement through the action of alkalis on silica and fireclay materials, to be confirmed.

Work on refractory insulating materials has been continued. This includes a study of the effect of the firing temperature on products made by the dry-press method from porous grog bonded with mixtures of fireclay and pulverized coal. The grog itself is made by firing fireclay and coal in different proportions. The work deals also with the application of refractory coatings to insulating bricks for the purpose of increasing resistance to spalling and to the action of slags. From tests on full-sized bricks it is shown that generally satisfactory mixtures can be prepared from several types of refractory grog bonded with ball clay. The testing of refractory materials is treated experimentally, with particular reference to the measurement of bulk density and of resistance to spalling.

The above investigations on refractory insulating materials represent one side of the work which has been carried out on refractories for gas and coke burning appliances. Another side deals with the temperature gradients occurring in a coke-fire back during the ignition, refuelling and dying out of the fire. It supplements the study described in the 32nd Report, and permits the graphical computation of stresses set up in the brick during the life of the fire.

The 33rd Report includes a further contribution to the study of the deformation of refractory materials under stress at high temperatures. As before, porcelain has been chosen as the material for experiment, and it has been examined in tension and torsion at temperatures from 900° to 1,100°C. The conception that the deformation may be regarded as a complex of elastic, viscous-elastic, and viscous effects is developed. Stress and time-hardening also occur over extended periods.

In view of the increasing interest in furnace linings prepared from unfired refractory preparations moulded in position, a survey of the properties of certain mixtures has been made and their suitability for this type of service compared.

Specifications Sub-Committee.

The Sub-Committee has continued to prepare recommendations for the revision, at an appropriate time, of the Standard Specifications for Refractory Materials for Gas-Works, issued by The Institution of Gas Engineers. Particular attention has been given to the difficult question of the sampling of refractory bricks and shapes.

Other Investigations

In addition to the investigations of the Joint Research Committee and the Refractory Materials Joint Committee, the work of the Gas Research Board has included the following practical investigations:

Luminescence Phenomena and Infra-Red Radiation.—It has been previously reported that the Second Arthur Duckham Research Fellow was investigating the phenomena of luminescence and infra-red emission associated with the impact of gas flames upon certain solid substances. This work has been continued during the past year.

The cause of the abnormal luminescence has been further studied, and it has been shown that this luminescence occurs when free hydrogen atoms, whether occurring in a flame or otherwise produced, come into contact with certain solids. The energy released by the re-combination of the hydrogen atoms at the solid surface is emitted almost wholly as light energy, little or no heat being communicated to the luminescent material. These discoveries have been protected by patent.

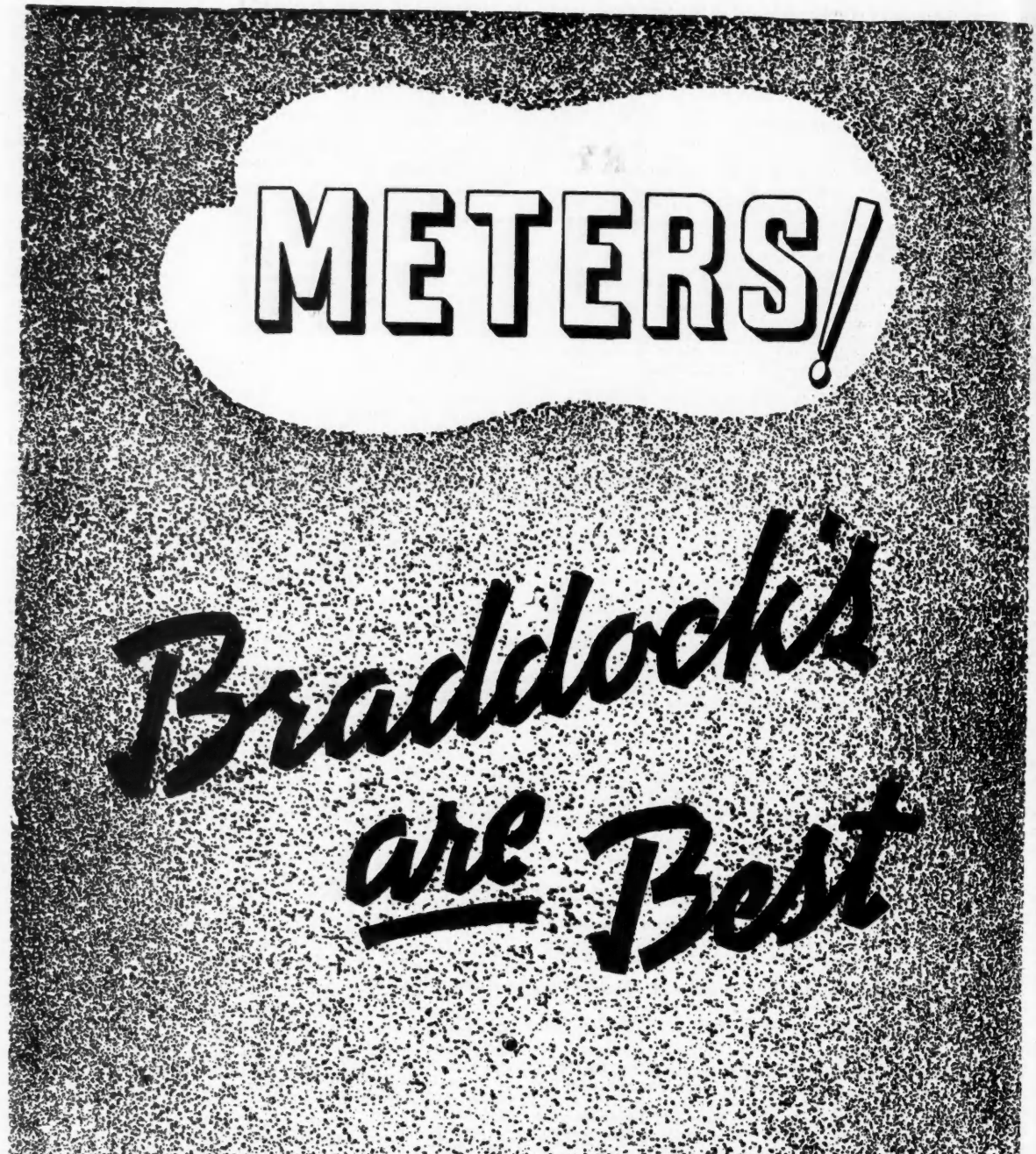
The infra-red radiation emitted by solids heated by a gas flame is being analyzed spectrographically and the emission maxima plotted for various solids and conditions. Such emission maxima are being compared with the absorption maxima in the infra-red of various solvents and vapours, and it is possible that the results of this work may lead to the practical application of the radiation from selective emitters and of gas-fired radiators generally to the drying of paints and other materials.

Dr. E. C. W. Smith, who relinquished his tenure of the Fellowship at the end of August, 1942, has been appointed a research physicist of the Board and a research assistant has also been appointed to assist in these investigations. The work has been somewhat delayed by the fact that Dr. Smith has been temporarily seconded to the Ministry of Home Security, at the particular request of the Ministry, to carry out an urgent investigation for which this experience particularly qualifies him.

Liquefaction of Gases.—The Joint Committee on Methane Synthesis, which consists of representatives of the Fuel Research Board and of the Joint Research Committee, has continued to maintain close contact with the work of Prof. A. C. G. Egerton (who is a member of the Committee) on the liquefaction of methane and other gases.

This work, to which reference was made in the 1st Annual Report of the Council, is of interest and importance to the Gas Industry not only on account of the possible separation of methane from coal gas and the like, for use as a fuel or as an enricher, but also of the possibilities of gas purification by the removal of impurities by fractional liquefaction and of the recovery of certain constituents of coal gas which have special applications in the chemical industry. For these reasons, the Council has appointed a research assistant who is collaborating in the investigations of Prof. Egerton at the Imperial College, and who is thereby also familiarizing himself with the high-pressure and low-temperature technique associated with the liquefaction of gases.

Benzole and Toluene.—The Gas Research Board has made an investigation of the approximate extent to which the yield per ton of coal of benzole, and more particularly of toluene, is increased by the cracking of tar injected into the charge during carbonization in a continuous vertical retort. The Benzole Advisory Committee of the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Mines Department has been interested in this investigation, although it is realized that under present circumstances the tar may be required for more urgent national purposes.

Wind Forces on Spirally-Guided Gasholders.—The results of tests carried out for the Gas Research Board at the National Physical Laboratory on the stresses imposed by wind upon the structure of spirally-guided gasholders, referred to previously, have been submitted to the Board in the form of a Report. The matter discussed is of a highly complex nature, but it is hoped to publish at least the principal conclusions in due course.

GAS INDUSTRY THOUGHT TREND

The following is the written reply of Mr. G. L. BRAIDWOOD to the discussion on his Paper to the Southern Association of Gas Engineers and Managers (Eastern District) on Nov. 26, see "JOURNAL" of Dec. 9:

The discussion was outspoken and extremely stimulating and I heartily agree with most that was said; but it was inevitably somewhat lengthy, and I had time to make only a few concluding remarks. I should like now to deal with one or two points in particular arising from certain remarks made.

First, a final word on education, which is of paramount importance, and which received quite a large measure of attention in the discussion. Undoubtedly big improvements are on the way, but the most disturbing feature about the present system and the worst accusation that can be levelled against it lies in the truth behind Prof. Laski's definition of education as "the art which teaches men to be deceived by the printed word"—in one word, gullibility. The present system turns out a vast majority who are unable or unwilling to think and reason for themselves or to decide whether there is a reasonable probability that a thing is true, who tend to take things for granted and are not endowed with an enquiring mind, and whose sense of values is shockingly out of proportion. Evidence of these failings is, as I have pointed out, all around us every day.

Mr. Chester hits the nail on the head when he points to the enormous disparity between the production cost and selling price of gas (though if by production he means net coal and manufacture I make it nearly 3 times, but if manufacture alone just over 5 times—not 6 to 8 times as he states). A close approximation to the average pre-war costs per therm of the large companies may be taken as: Net coal 1½d., manufacture 1¾d., distribution 2¾d., overheads 1½d., and the average selling price 9d., the balance being interest on loan capital and profit. The astonishing fact is that, excluding those companies which take the bulk of their gas from coke ovens, the highest costs in the case of net coal, manufacture, and total working expenses are about double the lowest, distribution about 2½ times, and the overheads considerably more (within this last item management is 4 times, rates and taxes 4½, and rents 20 times!); the revenue from both coke and tar is 3 times. There is surely here food for furious thought; and these facts are the more surprising as we are dealing only with the large companies and not with a collection of very small concerns. Should not co-ordination be able to effect a considerable evening up and diminution of these figures?

As Mr. Chester says, the Gas Industry knows at what price it must sell gas for space and water heating to compete with coal. This is in the neighbourhood of 4d. to 5d. per therm, and if we call it 4½d. it means that we have got to cut the average price charged to the private consumer in half.

Dr. Pexton rightly adjures us not to build unwarranted hopes on the outcome of Dr. Dent's work, though I have never been led to expect practicable results within any predictable time, and I wholeheartedly agree that until the time is ripe no anticipations should for a moment be allowed to influence our plans or divert us from striving for every possible economy and improvement. Dr. Pexton, who is a recognized authority on such matters, has recently done the Industry invaluable service by stressing the vital need for fuel economy and the methods whereby it may be achieved. If, as one is led to expect, some national fuel authority will in future be responsible for allocating the economic division of function of the various fuels, this aspect will be of the greatest importance by reason of its contribution to the efficiency of our coal processing and to national fuel conservation. At the same time, from the point of view of the cost of gas to consumer, the average fuel consumption (coke) of the large companies is 21%, the lowest being 16%, and if that average were reduced to the latter figure, this saving alone would not carry us very far along the road towards cheaper gas. In fact, if the net cost of coal disappeared altogether the selling price would still be 7½d. In other words, we must, as we know, "explore every avenue" with a vengeance if we are really to get costs down.

Surely the starting-point and the main factor on which our present hopes are based for cheaper gas is co-ordination and the linking up of suitable undertakings on a regional (and probably geographical) basis. The benefits arising from regional supply and control would probably include a saving in cost of raw materials, increased overall efficiency through pooled technical and administrative personnel in manufacture, distribution, and sales now lacking proper equipment and supervision, wider adoption of the best type of tariffs, increased output of some of the more scattered and smaller undertakings, and the supply of gas to districts hitherto lacking it. If by these means the cost of gas could be substantially reduced, the consumption of existing consumers would rapidly increase in addition to the extra load from new ones, and there should in consequence be a general tendency towards a reduction in the ovesheads, contributing towards cheaper gas still, and so on in a beneficent circle. We have to remember also that there is quite a large number of consumers to whom cost is not the only or necessarily the deciding factor, and who would turn over from solid fuel to gas, if the latter were not much more expensive, for the sake of the added convenience.

Mr. Chester does not visualize any appreciable cheapening of production costs; but surely cheaper methods of making gas imply not merely lower production costs *per se*, but other direct and indirect savings which may follow. For instance, we know that under certain conditions in the H.P. process large volumes of high-grade gas can be evolved, so that if processing costs could be reduced satisfactorily, it is already possible that ancillary plant and distribution might be cheapened and, if much more gas could be made by the same number of employees, perhaps the overheads also.

At any rate, on that happy day when complete or H.P. gasification is proved economical we shall be able in time to get rid of that trouble coke; and if, as Mr. E. V. Evans said in his Address to the Manchester District Association of Gas Engineers on Nov. 27, one among the contributions the Gas Industry should make is reduction in transport, there is no better way in which we could do it. Because coke has hitherto been complementary to gas, we, as purveyors of what we claim is the most refined, reliable, and adjustable fuel, need not delude ourselves that it is anything but a crude and inconvenient domestic fuel. So long as it remains it is a testimony of our failure to achieve the best possible service for the public.

Gas Meter Unions

The manufacture of gas meter unions is becoming increasingly difficult owing to the fact that the Government have had to impose restrictions on the use of brass.

Some firms have at times already found it necessary to supply meters without unions, of course making the appropriate allowance, and the meter maker firms feel it their duty to recommend gas undertakings to conserve their stocks and also to save for further needs any old unions which can be made usable. They urge that the use of new unions should be avoided as far as possible.

In these circumstances they suggest that undertakings should review stocks of unions and, wherever possible, endorse orders for meters "Without Unions." If the Gas Industry will uniformly adopt this course, the supply position will be considerably eased.

Library Facilities

Arrangements have now been made whereby members may, through application to the Secretary of The Institution of Gas Engineers, obtain books on loan from the Science Library, South Kensington. Where, therefore, books are not available in the library of the Institution, it is sometimes possible to obtain them on loan from the Science Library. Books may also sometimes be borrowed by the Institution from the National Central Library, through the Association of Special Libraries and Information Bureaux, of which the Institution is a member. Some members may not realize the extent of the sources of information available to them through the Institution.

Although reference books and periodicals may not be taken on loan from the library of the Institution, a number of members and others have taken advantage of the facilities available for the provision of photostat copies of particular articles. Information on this service may be obtained on application to the Secretary.

At Least 15,000 young men are wanted by March of next year to reinforce the existing body of miners. It was recently decided that certain men, between the ages of 18 and 25 at the time of registration, may, on becoming available for general service in the Forces, choose underground mining as an alternative to military service. Several hundred volunteers for the mines have already started work and the applications of many hundreds of others are being sifted.

A Joint Meeting of the Eastern and Western Districts of the Scottish Junior Gas Association was held on Dec. 5 in Glasgow. Mr. A. Shand (Falkirk), President of the Western Association, presided, and introduced Mr. D. L. Dickson, Airdrie, who presented a Paper on "Future Policy in Relation to Gas-Works Practice," which was followed by a discussion.

Gas Products Prices

The London Market Dec. 21.

The only item of interest in connexion with the London Coal Tar Products market is that fair quantities of Pitch are being sold on the basis of 45s. per ton naked at Makers' Works. Otherwise no change.

The Provinces Dec. 21.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 10d., pure, 2s. 5d. (controlled by the Control of Toluene No. 2 Order, July 3, 1941, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 1s. to 1s. 4d. according to quality. Solvent naphtha, naked, North, 2s. 2d. to 2s. 6d. Heavy naphtha, North, 1s. 10d. to 1s. 11d. Carbolic acid, 60's, controlled by the Coal Tar Acids Prices (Inland) Order, 1942, operative from May 1. Naphthalene, controlled by the Naphthalene prices (Inland) Order, 1942, dated April 15, 1942, and operative from May 1, 1942, £19 to £19 10s.—bags free. Anthracene, controlled by the Anthracene Prices (Inland) Order, 1942, operative from May 1. Filtered heavy oil (min. gr. 1,080), 7½d. to 8d. Creosote oil has been generally controlled as to direction and price for some time past. Current value—fuel grades 5d. to 5½d; timber preservation and other purposes 4½d. to 6d. These prices apply as from May 13.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Tar Products in Scotland Dec. 19.

Demand continues strong with production well maintained. Refined tar controlled. Value is 4½d. per gallon *ex* Works, naked. Creosote oil: Specification oil, 6½d. to 7d.; low gravity, 7½d. to 7½d.; neutral oil, 6¾d. to 7d. per gallon; all *ex* Works in bulk. Refined cresylic acid is changing hands in limited quantities at 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha: 6½d. to 7d. Solvent naphtha: 90/160 grade, 2s. 5d. to 2s. 6d., and 90/190 Heavy naphtha, 1s. 11d. to 2s. per gallon. Pyridine: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

Gas Stocks and Shares

The exploits of the Eighth Army gave a decided fillip to Stock Markets at the outset and at the close of last week, although business between these periods remained small and movements mixed. The demand for gas stocks and shares continued steady, and it will be seen below that with few exceptions all price changes were in an upward direction. Features in the Official List were the rise of 5s. in Cape Town 4½% preference to 45s., business being done at this price, and the gain of 8 points in East Surrey 5% debenture bringing it into line with the price of similar class stocks. On the Provincial Exchanges Weston-super-Mare 4% debenture closed 10 points higher at 96½.

The following price changes occurred during the week:

SUPPLEMENTARY LIST

Brighton 5 p.c. Deb. (*x.d.*)	115—120	Dec. 14
Cheltenham 4 p.c. Deb. (*x.d.*) ...	93—98	,,
Southampton 5 p.c. Red. Deb. (*x.d.*)	95—100	,,

PROVINCIAL EXCHANGES

Bristol 2nd 4 p.c. Deb.	100—102	+1
Liverpool Ord.	102—103	+3
Weston-Super-Mare 4 p.c. Deb. ...	94—99	+10

OFFICIAL LIST

Bombay	20/—21/-	+-/3d.
Bournemouth 4 p.c. Deb. (*x.d.*) ...	97—102	Dec. 14
British Ord.	80—85	+2
Cape Town 4½ p.c. Pref.	35/—55/-	+5/-
East Surrey 5 p.c. Deb.	115—120	+8
Gas Consolidation "B"	15/6—17/6	+-/6d.
Imperial Continental	78—83	−3
Oriental (*x.d.*)	85—90	Dec. 14
Primitiva 6 p.c. Red. Pref. (*x.d.*) ...	96—101	,,
South Metropolitan Ord.	73—78	−1
South Suburban 5 p.c. Deb. (*x.d.*) ...	115—120	Dec. 14
Southampton Ord.	73—78	+1
United Kingdom 4½ p.c. Pref. (*x.d.*)	14/—16/-	Dec. 14
Wandsworth 4 p.c. Pref.	83—88	+1
Ditto 5 p.c. Deb. (*x.d.*)	118—123	−2
Ditto 4 p.c. Deb. (*x.d.*)	95—100	Dec. 14
Watford Ord.	97—102	−1

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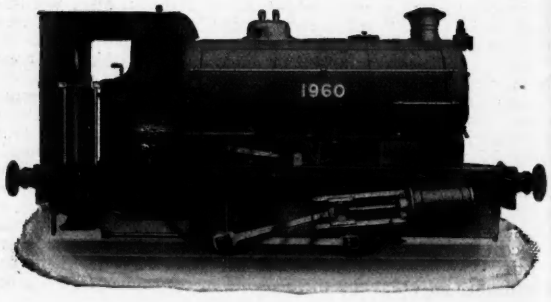

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